RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Programme Structure and Course Details

B. Tech. in Electrical and Electronics Engineering

2022-26

Faculty of Engineering and Technology

Dean – Academic Affairs
Ramaiah University of Applied Sciences
Bangalore

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Programme Specifications

B. Tech. (Electrical and Electronics Engineering) Degree Programme

Programme Code: 003

Faculty of Engineering and Technology

Batch 2022-2026

Dean – Academic Affairs
Ramaiah University of Applied Sciences
Bangalore

University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society
3. To promote health, human well-being and provide holistic healthcare
4. To provide technical and scientific solutions to real life problems posed by industry, businessand society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunitiesin the society by incubating and nurturing technology product ideas and supporting technology backed business
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in
7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrichthe experiences of faculties and students through research and developmental programmes

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Programme Specifications: B. Tech. (Electrical and Electronics Engineering)

Faculty	Engineering and Technology
Department	Electrical Engineering
Programme Code	003
Programme Name	B. Tech. (Electrical and Electronics Engineering)
Dean of the Faculty	Dr. Dilip Kumar Mahanty
Head of the Department	Dr. S. Malathi

1. **Title of the Award:** B. Tech. (Electrical and Electronics Engineering)
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Faculty of Engineering and Technology, M. S. Ramaiah University of Applied Sciences,Bengaluru
6. **Date of Programme Specifications:** July 2022
7. **Date of Programme Approval by the Academic Council of MSRUAS:** 14-08-2022
8. **Next Review Date:** May 2026
9. **Programme Approving Regulating Body and Date of Approval:**
10. **Programme Accredited Body and Date of Accreditation:**
11. **Grade Awarded by the Accreditation Body:**
12. **Programme Accreditation Validity:**
13. **Programme Benchmark:**
14. **Rationale for the Programme**

Electrical and Electronics Engineering is one of the most sought-after disciplines of engineering. Electrical engineering plays a vital role in problems associated with systems such as electric power generation, transmission, distribution and utilization. Designing, manufacturing and testing of electrical machinery and equipment have beenthere world over for many decades. Electrical engineering is a foundational discipline, critical to the success of many human enterprises.

Electrical engineers are critical to power sector, design and development of energy systems and communication systems. Indeed, virtually every product or service in modern life has probably been touched in some way by an electrical and electronics engineer. Electrical and Electronic engineers design, analyze, evaluate, develop, test and manufacture electrical products to meet the requirements of Power sector, Industry and society at large.

The electrical engineering programme at Faculty of Engineering and Technology at MSRUAS has been developed by the members of the faculty based on their teaching experience and long-standing interactions with various universities and industries in India and abroad.

The curriculum is outcome based and helps students to develop critical thinking abilities and imbibe relevant practical skills for a smooth transition from academics to real-life work environment. Opportunities are provided for the students to do their internship in India or abroad depending on their preferences.

The faculty interacts with the industry and business offering engineering and consultancy, product design and development services along with training modules to practicing professionals. The above-mentioned features of the programme and the faculty members' strong footing in industry and business make the programme unique. The student admitted to the programme in electrical engineering is given a strong foundation in real-life problem solving which is quite rare with many institutions offering similar programme.

The Faculty of Engineering and Technology at MSRUAS would like to offer electrical and electronic engineering programme to produce imaginative, creative and innovative electrical and electronic engineers.

15. Programme Mission

The purpose of the programme is creation of innovative problem solvers in multi-disciplinary settings, entrepreneurs and leaders applying the knowledge, understanding, cognitive abilities, practical skills and transferrable skills gained through systematic, flexible and rigorous learning in the chosen academic domain.

16. Graduate Attributes (GAs)

GA-1. Engineering knowledge: Ability to apply knowledge of mathematics, science, and Engineering fundamentals to solve complex problems in engineering

GA-2. Problem Analysis: Ability to analyze engineering problems, interpret data and arrive at meaningfulconclusions involving mathematical inferences

GA-3. Design and Development of Solutions: Ability to design an engineering system, component, or process to meet desired needs considering public health and safety, and the cultural, societal, and environmental considerations

GA-4. Conduct Instigations of Complex Problems: Ability to understand and solve complex engineering problems by conducting experimental investigations

GA-5. Modern Tool Usage: Ability to apply appropriate tools and techniques and understand utilization of resources appropriately to complex engineering activities

GA-6. The Engineer and Society: Ability to understand the effect of engineering solutions on legal, cultural, social, and public health and safety aspects

GA-7. Environment and Sustainability: Ability to develop sustainable solutions and understand their effect on society and environment

GA-8. Ethics: Ability to apply ethical principles to engineering practices and professional responsibilities

GA-9. Individual and Teamwork: Ability to work as a member of a team, to plan and to integrate knowledgeof various engineering disciplines and to lead teams in multidisciplinary settings

GA-10. Communication: Ability to make effective oral presentations and communicate technical ideas to abroad audience using written and oral means

GA-11. Project Management and Finance: Ability to lead and manage multidisciplinary teams by applying engineering and management principles

GA-12. Life-long learning: Ability to adapt to the changes and advancements in technology and engage in independent and life-long learning

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17. Programme Outcomes (POs)

B.Tech. graduates will be able to:

PO-1. Apply the knowledge of mathematics, science, basic engineering fundamentals, and engineering specialization to the solution of complex engineering problems

PO-2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO-3. Design solutions for complex engineering problems and design system components or processes thatmeet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO-4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PO-5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO-6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO-7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO-8. Apply ethical principles and commit to professional ethics and responsibilities and norms of theengineering practice

PO-9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO-10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PO-11. Demonstrate knowledge and understanding of the engineering and management principles and applythese to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO-12. Recognize the need for and have the preparation and ability to engage in independent and life-longlearning in the broadest context of technological change

18. Programme Goal

The programme goal is to produce graduates having critical, analytical and problem-solving skills, and ability tothink independently, and to pursue a career in Electrical and Electronics Engineering.

19. Program Educational Objectives (PEOs)

The objectives of the B.Tech. (Electrical and Electronics Engineering) programme are to:

PEO-1. To provide students with knowledge in mathematics, science and core engineering area to enable them to deliver efficient solutions for complex engineering problems using analytical and cognitive skills

PEO-2. To enable students to design and develop sustainable innovative solutions for industry and societal requirements by conducting engineering investigations through experimentation and usage of moderntools

PEO-3. To inculcate ethics, communication, leadership, soft, managerial and entrepreneurial skills for a successful career in industries and to engage in lifelong learning

20. Programme Specific Outcomes (PSOs)

At the end of the B. Tech. (Electrical and Electronics Engineering) program, the graduate will be able to:

PSO-1. Apply the knowledge of fundamentals in electrical engineering, power system, electronics engineering, embedded systems, power electronics and drives, to obtain solutions for complex problems in electrical domain and allied areas

PSO-2. Design and develop embedded control systems using the principles and concepts of Electromechanical, Electronics and Computer Engineering through experimentation and usage of modern tools to address industry and societal requirements

PSO-3. Demonstrate ethics, leadership qualities, communication, entrepreneurial skills and involvement in lifelong learning for the betterment of organization, environment and society

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21. Programme Structure:

Semester 1 (Physics Cycle)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTB101A	Engineering Mathematics-1	3	1	0	4	100
2	PYB102A	Engineering Physics and Laboratory	3	0	2	4	100
3	CEF101A	Engineering Mechanics	3	0	0	3	100
4	ECF102A	Elements of Electronics Engineering and Laboratory	3	0	2	4	100
5	MEF103A	Engineering Drawing	2	0	2	3	100
6	LAN101A	Constitution, Human Rights and Law	2	0	0	2	50
Total			16	1	6	20	550
Total number of contact hours per week			23				

Semester 1 (Chemistry Cycle)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTB101A	Engineering Mathematics – 1	3	1	0	4	100
2	CYB104A	Engineering Chemistry and Laboratory	3	0	2	4	100
3	MEF104A	Elements of Mechanical Engineering and Work shop Practice	2	0	2	3	100
4	EEF105A	Elements of Electrical Engineering and Laboratory	3	0	2	4	100
5	CSF106A	Elements of Computer Science and Engineering and Laboratory	3	0	2	4	100
6	TSN101A	Professional Communication	2	0	0	2	50
Total			16	1	8	21	550
Total number of contact hours per week			25				

Semester 2 (Physics Cycle)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTB102A	Engineering Mathematics-2	3	1	0	4	100
2	PYB102A	Engineering Physics and Laboratory	3	0	2	4	100
3	CEF101A	Engineering Mechanics	3	0	0	3	100
4	ECF102A	Elements of Electronics Engineering and Laboratory	3	0	2	4	100
5	MEF103A	Engineering Drawing	2	0	2	3	100
6	LAN101A	Constitution, Human Rights and Law	2	0	0	2	50
Total			16	1	6	20	550
Total number of contact hours per week			23				

Semester 2 (Chemistry Cycle)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTB102A	Engineering Mathematics – 2	3	1	0	4	100
2	CYB104A	Engineering Chemistry and Laboratory	3	0	2	4	100
3	MEF104A	Elements of Mechanical Engineering and Work shop Practice	2	0	2	3	100
4	EEF105A	Elements of Electrical Engineering and Laboratory	3	0	2	4	100
5	CSF106A	Elements of Computer Science and Engineering and Laboratory	3	0	2	4	100
6	TSN101A	Professional Communication	2	0	0	2	50
Total			16	1	8	21	550
Total number of contact hours per week			25				

SEMESTER 3

Semester 3							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTF201A	Engineering Mathematics-3	3	1	0	4	100
2	EEC201A	Signals and Systems	3	1	0	4	100
3	EEC202A	Electronic Circuits	3	1	0	4	100
4	EEC203A	Network Analysis	3	1	0	4	100
5	EEC204A	Digital Logic Design	3	1	0	4	100
6	EEC205A	Electrical Machines - 1	4	0	0	4	100
7	EEL206A	Digital Logic Design Laboratory	0	0	2	1	50
8	EEL207A	Electrical Machines Laboratory- 1	0	0	2	1	50
9	BTN101A	Environmental Studies	2	0	0	2	50
Total			21	5	4	28	750
Total Number of Contact Hours per week			30				
1	MTB103A	Additional Mathematics -1	3	0	0	3	100

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SEMESTER 4

Semester 4							
Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTF202A	Engineering Mathematics-4	3	1	0	4	100
2	EEC208A	Linear Integrated Circuits	3	1	0	4	100
3	EEC209A	Electromagnetic Theory	3	1	0	4	100
4	EEC210A	Microprocessors and Microcontrollers	3	1	0	4	100
5	EEC211A	Measurement and Instrumentation	3	1	0	4	100
6	EEC212A	Electrical Machines - 2	3	1	0	4	100
7	EEL213A	Electrical Circuits and Measurements Laboratory	0	0	2	1	50
8	EEL214A	Microprocessors and Microcontrollers Laboratory	0	0	2	1	50
9	BAU201A	Innovation and Entrepreneurship	3	0	0	3	100
		Total	**21**	**6**	**4**	**29**	**800**
Total Number of Contact Hours per week			**31**				
	MTB104A	Additional Mathematics -2	3	0	0	3	100

SEMESTER 5

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	EEC301A	Transmission and Distribution	4	0	0	4	100
2	EEC302A	Digital Signal Processing	3	1	0	4	100
3	EEC303A	Control Systems	3	1	0	4	100
4	EEC304A	Electrical Machine Design	4	0	0	4	100
5	EEC305A	High Voltage Engineering and Laboratory	3	0	2	4	100
6	EEC306A	Engineering Economics	3	0	0	3	50
7	EEL307A	Electrical Machines - 2 Laboratory	0	0	2	1	50
8	EEL308A	Control System Laboratory	0	0	2	1	50
Total			**20**	**2**	**6**	**25**	**650**
Total number of contact hours per week			**27 hours**				

SEMESTER 6

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	EEC310A	Design and Computer Aided Drawing of Electrical Machine	3	0	2	4	100
2	EEC311A	Switchgear and Protection	3	1	0	4	100
3	EEC312A	Power Electronics and Drives	3	1	0	4	100
4	EEC313A	Power System Analysis	3	1	0	4	100
5	EEE3XXA	Professional Core Elective – 1	4	0	0	4	100
6	EEL315A	Power Electronics and Drives Laboratory	0	0	2	1	50
7	EEL316A	Power Systems Simulation Laboratory	0	0	2	1	50
8	EEP317A	Seminar	0	0	2	1	50
Total			**19**	**2**	**8**	**23**	**700**
Total number of contact hours per week			**29 hours**				

Number of credits can be registered	Minimum	21	Maximum	25

SEMESTER 7

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	EEE41XXA	Professional Core Elective - 2	4	0	0	4	100
2	EEE42XXA	Professional Core Elective - 3	4	0	0	4	100
3	OEE41XXA	Open Elective - 1	3	0	0	3	100
4	EEP401A	I] Project Work – 1	0	0	12	6	200
	EEI401A	II]Internship (Choose one)					
Total			**11**	**0**	**12**	**17**	**500**
Total number of contact hours per week			**23 hours**				
Number of credits can be registered			**Minimum**	**13**		**Maximum**	**17**

SEMESTER 8

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	EEP411A	Project Work - 2	0	0	24	12	300
Total			**00**	**00**	**24**	**12**	**300**
Total number of contact hours per week			**24 hours**				
Number of credits can be registered			**Minimum**	**12**	**Maximum**		**12**

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Professional Core Elective Courses:

Stream → / Group ↓		Power Electronics	Power Systems	Control Systems	Common Group	Applied Mathematics
PCE-1 Sem.6	Course Code	EEE311A	EEE312A	EEE313A	MTE301A	MTE302A
	Course Title	Power Converter Control Techniques	Electrical Power Generation	Advanced Control System	Probability and Statistics	Advanced Mathematics
PCE-2 Sem. 7	Course Code	EEE411A	EEE412A	EEE413A	CSE411A	MTE401A
	Course Title	Industrial Drives and Applications	Power System Operation and Control	Soft Computing	Data Sciences and Foundation	Optimization Techniques -1
PCE-3 Sem.7	Course Code	EEE421A	EEE422A	EEE423A	CSE431A	MTE402A/MTE403A
	Course Title	Modelling and Control of Power Electronics System	Testing and Commissioning of Electrical Equipment's	PLC and SCADA	Data Analytics	Optimization Techniques -2/ Advanced Numerical Methods

Note:

Students are required to select two Professional Core Elective Courses in the 7th Semester, one each from PCE-1 andPCE-2 Groups.

Students are required to select one Professional Core Elective course in the 8th Semester from the PCE-3 Group.

22. Open Elective Courses

A number of Open Elective Courses from Faculties of engineering, management and commerce, art and design, hospitality management and catering technology, pharmacy, dental sciences are offered as mentioned in the University's website. Students can choose the Open Electives on their own choice.

22.1. Innovation Courses in Lieu of Open Elective Courses

Students can take the following 3-credit innovation courses in lieu of Open Elective Courses.

a) Design Thinking and Innovation (INO250A)
b) Skill Development (INO251A)
c) Industrial Problem Solving and Hackathons (INO252A)

23. Course Delivery: As per the Timetable

24. Teaching and Learning Methods

1. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises

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9. Project Work
10. Project
11. Exhibitions
12. Technical Festivals

25. Assessment and Grading (Subject to endorsement of revised unified academic regulations for 2022-23-reportsubmitted)

25.1. Components of Grading

Continuous evaluation depends on the type of the course as discussed below:

25.1.1 Theory Courses

Theory Course				
Sub Component	SC1 (Midterm Exam)	SC2 (Assignment - 1)	SC3 (Assignment -2 Innovative Component)	SC4 (Optional- Makeup midterm. To be offered with approval)
Weightage	25 %	12.5%	12.5%	25%
Marks	50	25	25	50

For a theory course, there shall be three subcomponents of CE (SC1, SC2 and SC3). Each subcomponentis evaluated individually as indicated in the table. It is mandatory that the first and the second components (SC1 and SC2) have to compulsorily be a midterm exam and an assignment respectively. The third component (SC3) has to be an innovative component and the activities to be spread over theentire semester. The third component can be any of the following types:

a) Online Test
b) Assignments/Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task
i) Any other

After the three subcomponents are evaluated, the CE component marks are determined as: CE Component Marks = (Total of the marks obtained in all the three subcomponents) ÷ 2

25.1.2 Laboratory Course

For a laboratory course, the scheme for determining the CE marks is as under:

Laboratory Course			
Sub Component	SC1	SC2	SC3 (Optional)
Weightage	25 %	25%	25%

Marks	25	25	25

The subcomponents can be of any of the following types:

a) Laboratory / Clinical Work Record

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b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) Any other (e.g. combinations)

After the subcomponents of CE are evaluated, the CE component Marks are determined as: CE Component Marks = (Total of the best two subcomponent marks out of the three) ÷ 2

25.1.3 Course Having a Combination of Theory and Laboratory

For a course that contains the combination of theory and laboratory sessions, the scheme for determining the CE marks is as under:

	Theory Course				
Sub Component	SC1 (Midterm Exam)	SC2 (Assignment - 1)	SC3 (Assignment -2 Innovative Component)	LSC4 (Laboratory Component)	SC4 (Optional- Makeup midterm .To be offered with approval from authorities)
Weightage	20 %	10%	10 %	10%	25%
Marks	50	25	25	25	50

For a course having a combination of theory and laboratory, there shall be four sub-components of CE (SC1, SC2,SC3 and LSC4). Each subcomponent is evaluated individually as indicated in the table. It is mandatory that first and the second components (SC1 and SC2) have to compulsorily be a midterm exam and an assignment respectively. The third component (SC3) has to be an innovative component and the activities to be spread overthe entire semester. The fourth subcomponent (LSC4) is mandatory and shall be set to evaluate the students' performance in the laboratory. The third component can be any of the following types:

The theory assignment can be of any of the following types:

a) Online Test
b) Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task

The laboratory subcomponent can be of any of the following types:

a) Laboratory / Clinical Work Record
b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) Any other (e.g. combinations)

After the four subcomponents are evaluated, the CE component marks are determined as: CE ComponentMarks = (Total of the marks obtained in all the four subcomponents) ÷ 2

26. Minor Programme

The details of the following aspects of the minor programmes are presented in the **Academic Regulations** for the B.Tech. Degree Programme:

1. Programme Structure
2. Eligibility to Minor Programme
3. Registration to Minor Programme
4. Certification for Minor Programme

27. Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals
4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility
8. Staff Support
9. Lounges for Discussions
10. Any other support that enhances their learning

28. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
3. Student Feedback
4. Moderation of Assessed Work
5. Opportunities for students to see their assessed work
6. Review by external examiners and external examiners reports
7. Staff Student Consultative Committee meetings
8. Student exit feedback
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

29. Programme Map (Course-PO-PSO Map)

Sem.	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
1	Engineering Mathematics - 1	3	3	2	3						2			3	3	2
1	Engineering Chemistry and Laboratory	3	3	3	2		3	3			3			3	2	
1	Elements of Mechanical Engineering and Workshop Practice	3	3											3		
1	Elements of Electrical Engineering and Laboratory	3	3	3	2	2	2	2		1	1	1	1	3	2	1

1	Elements of Computer Science and Engineering and Laboratory	2	1	3	2	2	2		1			1	2	3	2	2
1	Professional Communication									3	3					3
2	Engineering Mathematics - 2	3	3	2	2	2					1			3	2	1
2	Engineering Physics and Laboratory	3	3	3	3	1	1	1						3	3	
2	Engineering Mechanics	3	3	3										3		
2	Elements of Electronics Engineering and Laboratory	3	3											3		
2	Engineering Drawing	3	2			2					1			3	2	1
2	Constitution, Human Rights and Law	2	2	3				3				3	2	2	3	2
3	Engineering Mathematics - 3	3	3	2	2	2					1			3	2	1
3	Signals and Systems	3	3	2	2	2				1	1			3	2	1
3	Electronic Circuits	3	3	1	2		2				1	1		3	2	1
3	Network Analysis	3	3	3	2	2				1	1	1		3	2	1
3	Digital Logic Design	3	3	2	2	1	1	2					1	3	2	1
3	Electrical Machines - 1	3	3	3	3		3	2			1	1		3	3	1
3	Digital Logic Design Laboratory	3	3	2	2	1	1	2					1	3	2	1
3	Electrical Machines Laboratory- 1	3	3	3	2		3	2						3	3	
3	Environmental Studies	1					3		1					1	3	1
4	Engineering Mathematics - 4	3	3	2	2	2					1			3	2	1
4	Linear Integrated Circuits	3	3	3	3	3	3				1		1	3	3	1
4	Electromagnetic Field Theory	3	3		1	3				1		2	1	3	2	2
4	Microprocessors and Microcontrollers	3	2	2	2	2					2	2	2	3	2	2
4	Measurement and Instrumentation	3	2	2	2	2	2				2	1	2	3	2	2
4	Electrical Machines - 2	3	3	3	3									3	3	
4	Electrical Circuits and Measurements Laboratory	3	3	3	2	2				1	1			3	2	1
4	Microprocessors and Microcontrollers Laboratory	3	3	2	2	2					2	2	2	3	2	2
4	Innovation and Entrepreneurship	1					3		1					1	3	1
5	Transmission and Distribution	3	3	2	2	1	1	2					1	3	2	1
5	Digital Signal Processing	3	3	2	3	3	2			1	2		1	3	3	2
5	Control Systems	3	3	3	3	3	3	1	3	3	1	2	3	3	3	3
5	Electrical Machine Design	3		3	3	2	1	2	2				2	3	3	2
5	High Voltage Engineering and laboratory	3	3	3	3	3	3	1				1	1	3	3	1
5	Engineering Economics	1		2			3	2	3	2	3		3	2	3	3
5	Electrical Machines - 2 Laboratory		3	2	3	2		1	3	3	2	3		3	3	3
5	Control System Laboratory	3	3	2	2	3				1				3	3	1
6	Design and Computer Aided Drawing of Electrical Machine	3	3	3	2	3	3							3	3	
6	Switchgear and Protection	3	3	2	3	2						1	1	3	3	1
6	Power Electronics and Drives	3	3	3	3	3		1		1	1			3	3	1
6	Power System Analysis	3	2	1	1	2				1	1		2	3	2	2
6	Power Converter Control Techniques	3	3	1	3	3		3			1			3	3	3
6	Electrical Power Generation	3	3	3	2	2				1	1		1	3	2	1
6	Advanced Control System	3	3	3	3	3	3	3	1	3	1	2	2	3	3	3
6	Probability and Statistics	3	3	2	2						2			3	2	2
6	Advanced Mathematics	3	3	2	3						2			3	3	2
6	Power Electronics and Drives Laboratory	3	3	3	3	3	3	2		3	3	1		3	3	3

6	Power Systems Simulation Laboratory	3	2	2	2	2					2		1	3	2	2
6	Seminar	3	3		1		1	1	1	2	3		3	3	1	3
7	Industrial Drives and Applications	3	3	3	2	3		1		1	1			3	3	1
7	Power System Operation and Control	3	3	2	3	3						1	1	3	3	1
7	Soft Computing	3	3	3	3	3	3	3	1	3	1	2	2	3	3	3
7	Data Sciences Foundation	2	1	3	2	2	2		1			1	2	3	2	2
7	Optimization Techniques – 1	3	3	3			1				2			3	1	2
7	Modelling and Control of Power Electronics System	3	3	3	2	2	2			1	1			3	2	1
7	Testing and Commissioning of Electrical Equipment's	1		2			3	2	3	2	3		3	2	3	3
7	PLC and SCADA	3	3	3	3	2	3	2						3	3	
7	Data Analytics	2	1	3	2	2	2		1			1	2	3	2	2
7	Advanced Numerical Methods	3	3	2	2	2					2			3	2	2
7	Optimization Techniques – 2	3	3	3			1					2		3	1	2
7	Project Work-1	3	3	3	2	3	2	1	1	3	2	2	1	3	3	3
7	Internship	3	3	2	2	3	2	2	2	2	2	2	3	3	3	3
8	Project Work-2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

30. Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledge and networking.

31. Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning and organizing the activities.

32. Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held to demonstrate sportsmanship and competitive spirit.

Dean – Academic Affairs
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Course Specifications: Engineering Mathematics - 1

Course Title	Engineering Mathematics - 1
Course Code	MTB101A
Course Type	Core Theory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

The course introduces students to the basic concepts in real analysis and matrix algebra. Students are taught the concepts of limits, continuity, and differentiation, series expansion forthe functions of one and two variables, sequence and series, convergence of series. The mathematical operations in Matrix theory, Eigen value and Eigen vector, Inversion and diagonalization of matrix and matrix solution for linear system of equations.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. State and discuss basic concepts related to single, two variable calculus and matrixalgebra
CO-2. Perform basic operations of matrix algebra and apply them to solve systems of linearequations
CO-3. Solve simple mathematical problems associated with linear algebra, single and twovariable calculus
CO-4. Demonstrate competence with the basic ideas of linear systems, independence, bases and dimension, linear transformations, eigenvalues, eigenvectors and diagonalization
CO-5. Solve complex real-world problems associated with linear algebra, single and twovariable calculus

4. Course Contents

Unit 1 (Single Variable Calculus): Functions of single real variable, limit, continuity and differentiation. Rolle's Theorem and Lagrange's mean value theorem and their applications. Fundamental theorem of integral calculus. Improper integrals - classification and convergence,gamma and beta functions. Sequence of real numbers, Series, Tests for convergence of series: integral test, comparison test, ratio test and root test. Power series, Taylor and Maclaurin series. **Unit 2 (Two Variable Calculus):** Functions of two variables, limits, continuity and partial differentiation. Total differential, errors and approximations, tangent plane approximation of asurface. Partial differentiation of composite and implicit functions, Taylor's theorem. Unconstrained and constrained extrema.

Unit 3 (Linear Algebra): Matrix algebra, elementary row operations, row and reduced row echelon forms. Linear system of equations, existence and uniqueness of solution. Vector spaces, subspaces, linear independence, basis and dimension. Row, column and null space of a matrix.Linear transformations. Eigenvalues, eigenvectors and diagonalization.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2							1			3		1
CO-2	3	3	1							1			3		1
CO-3	3	3	2	3						2			3	3	2
CO-4	3	3	2	2						2			3	2	2
CO-5	3	3	2	2						2			3	2	2
			3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the followingTable.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shallprovide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. James Stewart, 2015, Calculus: Early Transcendental, 8th edition, Boston,Cengage Learning

2. Steven Leon, 2014, Linear Algebra with Application, 9th edition, New Jersey, Pearson

b. Recommended Reading

1. Maurice D. Weir and Joel Hass, 2017, Thomas Calculus, 13th edition, NewJersey, Pearson
2. Gilbert Strang, 2016, Introduction to Linear Algebra, 5th edition, Massachusetts, Cambridge Press

c. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

d. Other Electronic Resources

1. https://ocw.mit.edu/index.htm
2. https://www.khanacademy.org/
3. tutorial.math.lamar.edu/

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Course Specifications: Engineering Physics and Laboratory

Course Title	Engineering Physics and Laboratory
Course Code	PYB102A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

e. Course Summary:

The aim of this course is to impart concepts of Physics and its application to solve engineering problems. The students are taught the basic topics in modern physics which include wave particle duality, uncertainty principle, Schrodinger's wave equation, lasers and fiber optics. Electrical and mechanical properties of materials will be discussed in relation to the crystal structure. This course also intends to expose the students to the challenges and rewards related to experimental physics. Students gain hands-on experience by conducting experiments in a controlled laboratory environment. Students are trained to conduct experiments related to mechanics, optics and electric circuits. They are trained to analyze the measurements, results and infer appropriate conclusions basedon fundamental concepts of physics

f. Course Size and Credits:

Number of credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total hours of interaction	75
Number of Weeks in a Semester	15
Department responsible	Physics
Total Course Marks	100
Pass requirement	As per the Academic Regulations
Attendance requirement	As per the Academic Regulations

g. Course Objectives (CO)

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

CO - 1	State, explain the concepts of mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser and fiber optics
CO - 2	Derive standard relationships in mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser & fiber optics, and interpret them
CO - 3	Discuss the applications of mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser and fiber optics
CO - 4	Solve problems in mechanics, electrical conductivity, quantum mechanics, crystal structure, material science, laser and fiber optics
CO - 5	Plan the experimental set-up, conduct experiments, calculate and plot the graphs to obtain the results and write a laboratory report as per the Prescribed format.

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h. Course Contents

Unit 1 – (Elasticity): Review of Elasticity — Expression for Y, h and K in terms of linear and lateral strains (Deformation of a cube)—Poisson's ratio—Twisting couple on a cylinder—Expression for couple per unit twist—Torsion Pendulum -- determination of rigidity modulus of a wire using torsion pendulum—Bending of beams— Geometrical moment of inertia of circular and rectangular cross sections—Single cantilever—Expression for Young's modulus of a cantilever beam

Unit 2 – (Rigid body dynamics): Review of Rigid body dynamics — Expressions for moments ofinertia of a circular disc and rectangular plate about different axes—MI of Flywheel

Unit 3 – (Quantum theory of radiation): Blackbody spectrum—Wien's law—Raleigh-Jeans law—Stefan-Boltzmann law—Planck's quantum theory—Reduction of Planck's formula to Raleigh Jeans and Wien's formulae—Compton effect—Wave particle dualism—de Broglie hypothesis and matter waves—Phase velocity and group velocity of matter waves

Unit 4 – (Quantum Mechanics): Heisenberg's uncertainty principle—Applications of Heisenberg's uncertainty principle—wave function and its properties - Setting up of Schrodinger's one-dimensional time independent wave equation—Application of Schrodinger's equation to a particle in an infinite potential well to determine eigen values and eigen functions

Unit 5 – (Lasers): Interaction of radiation with matter - Absorption, spontaneous emission and stimulated emission - Characteristics of laser light - Expression for the energy density of electromagnetic radiation – Requisite conditions for production of a laser beam—Helium-Neon laser—Semiconductor laser—Applications of lasers—Lidar—laser isotope separation—laser fusion

Unit 6 – (Optical Fibers): Principle-- Angle of acceptance—Expression for Numerical aperture--condition for propagation—Intermodal dispersion-- material dispersion—Refractive index profiles of step index and graded index fibers(GRIN)—Modal propagation in step index and GRIN fibers – Attenuation—Different types of loss mechanisms--Fiber optic communication system

Unit 7 – (Crystal structure): Space lattice—Bravais lattice—Lattice parameters—unit cell and primitive cell—Crystal systems - Miller indices - Indexing directions and planes in a crystal - Atomic packing fraction and coordination number for simple, body centered and face centered cubic Crystals - Expression for inter planar Spacing - Structures of NaCl and diamond crystals— Bragg's law—Identification of cubic crystals using Bragg's law

Unit 8 – (Electrical conductivity of metals): Review of Classical free electron theory - Failure of classical free electron - Quantum free electron theory—Density of States (Qualitative) – Fermi energy – Fermi factor - Effect of temperature on Fermi-Dirac Distribution function

Unit 9 – (Lab Experiments)

1. Determination of the relationship between the torque and angular acceleration of a flywheel
2. Determination of the (i) the moment of inertia of the given disc and (ii) the rigidity modulus of the material of a wire by torsional oscillations
3. Analysis of Powder X-ray diffraction pattern.
4. Determination of Young's modulus of material of a beam by uniform bending method.
5. Determination of radius of curvature of a plano-convex lens by setting up Newton's rings.
6. Determination of the wavelength of prominent spectral lines of Hg source using diffraction grating with minimum deviation method.

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7 Determination of thickness of paper by air wedge experiment.
8 Determination of efficiency of Solar cell.
9 Determination of Planck's constant using LED.
10 Study of I-V characteristics of Zener diode
11 Determination of the frequency response of series and parallel resonance circuit and to find the resonant frequency and quality factor.
12 Determination the width of the forbidden energy gap in a semiconductor diode.
13 Determination of dielectric constant of a material by charging and discharging a capacitor.

i. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3		2		1								3	1	0
CO-2	2	1	3	3		1	1						3	2	0
CO-3	3	2											3	0	0
CO-4	3	2	2	1									3	1	0
CO-5	3	2		3			2		1	2			3	3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

j. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		13
1. Solving Numerical Problems	13	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Mid Terms, Written Examination		10
Total Duration in Hours		85

k. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment is presented in the Programme Specifications document pertaining to the B. Tech. Programmes. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3 or LSC4), COs are assessed as illustratedin the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
Course Outcomee	CE (Weightage: 50 %)				SEE (Weightage :35 %)	Lab (Weightage: 15 %)
	TSC1: (20 %) Midterm exam	TSC2: (10 %) Assignment	TSC3: (10 %) Innovative	LSC4: (10 %) CE	Written exam	LSEE: SEE
	50 marks	25 Marks	25 Marks	25 Marks	100 Marks	25 Marks
CO-1	X		X		X	
CO-2	X	X	X		X	
CO-3	X	X	X		X	
CO-4	X	X	X		X	
CO-5				X		X
The details of TSC1, TSC2, TSC3 or LSC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8 Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No.	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Class room lectures, and demonstrations
3.	Critical Skills	Assignment
4.	Analytical Skills	Class room, assignment
5.	Problem Solving Skills	Class room, assignment
6.	Practical Skills	Class room, assignment
7.	Group Work	Classroom
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination

10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Course
13.	Information Management	Assignment, examination
14.	Personal Management	Assignment, examination
15.	Leadership Skills	Effective management of learning, time management, achieving the learning

9. Course Resources

a. Essential Reading

1. Class Notes
2. Rajendran, V. (2011) Engineering Physics, TMH
3. Srinivasan M. R. (2011) Physics for Engineers, 3rd Ed, New Age International
4. Gyan Prakash, (2012) Experimental Physics,
5. Michael Sayer, Abhai Mansingh, (1999) Measurement, Instrumentation and Experiment Design in Physics and Engineering, PHI

b. Recommended Reading

1. Halliday, I.D., Resnick, R and Walker, J (2010) Fundamentals of Physics, 9thEd, Wiley
2. Richtmeyer, F. K., Kennard, E.H. and Cooper, J.N (2007) Modern Physics, 6thEd, TMH
3. Beisser, A. (2009) Concepts of Modern Physics, 6th Ed, TMH
4. Kittel, C. (2010) Introduction to Solid State Physics, 8th Ed, Wiley
5. S.O. Pillai (2011), A Textbook of Solid State Physics, 6th Ed, New AgeInternational
6. Srinivasan M.R. (2011) Applied Solid State Physics, 1st Ed, New AgeInternational
7. Giri, P.K., (2005) Physics Laboratory Manual for Engineering Undergraduates, Department of Physics, Indian Institute of Technology Guwahati

c. Websites

1. http://nptel.ac.in/
2. Other Electronic Resources

d. Electronic resources on the subject area are available on MSRUAS library

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Course Specifications: Engineering Mechanics

Course Title	Engineering Mechanics
Course Code	CEF101A
Course Type	Core Theory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This subject deals with laws of engineering mechanics for static and dynamics equilibrium of rigid bodies. They will be trained on application of engineering mechanics to solve practical problems pertaining to static and dynamic equilibrium of rigid bodies. In addition, effects of friction, energy methods for analyzing static and dynamic analysis of rigid bodies will be dealt.

2. Course Size and Credits

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. State and describe the laws of Statics, Friction and Dynamics and their contexts of application.
CO-2. Interpret standard mathematical relationships and apply for solving simple static and dynamic problems in engineering mechanics
CO-3. Calculate moment of inertia, determine centroid, centre of gravity for the structural members
CO-4. Apply the laws of statics and dynamics for the equilibrium analysis of rigid bodies with and without friction
CO-5. Apply energy methods in analyzing of static and dynamic aspects of engineering structures made of rigid bodies

4. Course Contents

Unit 1 (Engineering Mechanics): Branches of mechanics and its importance: Engineering Design , Mechanics in engineering, Introduction to SI units , Basic idealisations - Particle, Continuum, Rigid body and Point force with examples, principles of mechanics with examples- laws of parallelogram, law of transmissibility, gravitation, Classification of force and force systems; Principle of physical independence of forces, Principle of superposition of forces; constraints on rigid bodies and corresponding reactions, Moment of a force, couple, moment of a couple, characteristics of couple,

Equivalent force - couple system; Resolution of forces, composition of forces; Numerical problems on moment of forces and couples, equivalent force and couples.

Unit 2 (Analysis of Coplanar Concurrent and Non-Concurrent System of Forces): Varignon's theorem, resultant of Concurrent and non-concurrent force systems. Equilibrium of Structural Systems: Types of forces acting on a body, Free Body diagram Analysis, Lami's Theorem, Equilibrium of connected bodies, types of supports in beams, determination of support reactions, Applications to engineering problems. Classification of Structures –Axial force members, trusses, frames, beams and cables, Numerical Examples.

Unit 3 (Centroid of planes and Moment of inertia of area): Differences between centre of gravity and Centroid, use of axis of symmetry, Centroid of simple built-up sections by integration, Moment of Inertia of planes, radius of gyration, Theorems of moment of inertia, moments of inertia of standard sections by integration, Numerical Examples.

Unit 4 (Friction in Engineering Systems): Laws of friction, angle of friction, angle of repose, cone of friction, Analysis of blocks resting on horizontal and inclined planes, rolling friction, rope friction, Application to wedge and ladder problems, problems involving non concurrent force systems.

Unit 5 (Energy methods in engineering mechanics): Application of principle of virtual work and Castigliano's theorem. Energy relations in rigid bodies- conservation of energy principle, examples on kinetic energy, potential energy and total energy, power as applied to rigid bodies.

Unit 6 (Introduction to dynamics): General principles and types of motions and D'Alembets principle with examples, Newton's laws of motion. Linear motions and projectiles -Motion with uniform velocity and acceleration, motion with varying acceleration, motion of bodies projected horizontally, projection on inclined planes, Numerical examples.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3	3											3		
CO-4	3	2	1										2		
CO-5		2	3										3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		0
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	

3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignment
2.	Understanding	Classroom lectures, Assignment, Self-study
3.	Critical Skills	Classroom lectures, Assignment
4.	Analytical Skills	Classroom lectures, Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Assignment, Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Satheesh Gopi (2010), Basic Civil Engineering, Dorling Kindersley (India) PvtLtd
3. R K Rajput (2011), A Text Book of Applied Mechanics, 3rd Edn, LaxmiPublications
4. Richard H. McCuen, Edna Z. Ezzell (2011), "Fundamentals of Civil Engineering: An Introduction to the ASCE Body of Knowledge", CRC press

b. Recommended Reading

1. S. S. Bhavikatti, K. G. Rajashekarappa (2004), Engineering Mechanics, NewAge International
2. C. Lakshamanarao, J. Lakshinarashiman, Raju Sethuraman, Srinivasan M. Sivakumar (1993), Engineering Mechanics: Statics and Dynamics, PHI, NewDelhi

c. Other Electronic Resources

1. https://nptel.ac.in/

Course Specifications: Elements of Electronics Engineering and Laboratory

Course Title	Elements of Electronics Engineering and Laboratory
Course Code	ECF102A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to create a strong foundation of Digital Electronics. The students are taught the basic components of digital systems and the process of their implementation. The students are also taught Boolean algebra, logic gates, basics of memories, and implementation of combinational and sequential digital circuits using logic gates. This course also emphasizes on different types of memories and logic designing platforms and their merits and demerits. Students are trained to employ the principles of digital electronics to implement digital design for the given problem. Basic electronics laboratory deals with practical applications of electronic circuits and their theoretical concepts.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:2
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain working principles of PN junction diode, Zener diode, transistors, amplifier configurations, Op-Amps, power supply, logic gates and electronic displays
CO-2. Derive mathematical relationships for electronic devices and circuits
CO-3. Solve simple numerical and design problems related to analog / digital circuits as well as devices
CO-4. Design and analyse operation of standard analog / digital circuits for a given application
CO-5. Conduct experiments as per the standard procedures and tabulate/calculate/plotthe measured values
CO-6. Interpret and compare with standard results, and draw conclusions and Write reportas per the prescribed format

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4. Course Contents

Unit 1 (Basic concepts in Electronics): Semiconductor: p-type, n-type; p-n junction diode, its characteristics, half wave, full wave and bridge type rectifiers, basic filter circuits, Diode as voltage multiplier, clipper and clamper circuit, Zener diode characteristics, Zener diode as a voltage regulator.

Unit 2 (Transistor- BJT): Transistor configurations: CB, CE and CC; Transistor parameters: alpha, beta and gamma, working of transistor as a switch, Amplifier; Transistor biasing – Base, Collector-to-base and Voltage Divider Bias.

Unit 3 (Amplifiers): Differential amplifiers and their transfer characteristics, IC Op-Amps, their ideal and practical characteristics, Op-Amp in different modes as inverting amplifier, non- inverting amplifier, summing amplifier, scale changer, differentiator and integrator.

Unit 4 (Power Supplies): Introduction and working of Switched Mode Power Supply (SMPS), Voltage Regulator, Introduction to Inverters and UPS.

Unit 5 (Digital Electronics): Binary, Octal and Hexadecimal number systems and conversions, Boolean Algebra, Truth table of logic gates- AND, OR, NOT, NAND, NOR; Universal gates; Generation of Integrated Circuits- SSI, MSI, LSI and VLSI.

Unit 6 (Laboratory): List of Experiments

1	Forward and Reverse bias V-I Characteristics of a P-N Junction diode
2	Forward and Reverse bias V-I Characteristics of Zener diode
3	Half wave and Full wave Rectifier circuits: a) Output of half/full wave rectifier with and without capacitor filter.
4	Bridge Rectifier circuits: a) Output of bridge rectifier with and without capacitor filter
5	Clipping circuits (Shunt clippers) Clipping circuits (Series clippers)
6	Clamping circuits
7	Characteristics of Op-amp inverting and non- inverting amplifiers
8	Logic Gates circuits: Verification of the truth tables of AND, OR, NOT, NAND, NOR and EX-OR gates.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3		3	2										3		
CO-4		3	2										3		
CO-5		3											3		
CO-6		3		2									3	2	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		33
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CEor SEE) or subcomponent of CE (TSC1, TSC2, TSC3 and LSC4), COs are assessed as illustrated in thefollowing Table.

Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	**CE (Weightage: 50 %)**			**SEE (Weightage: 35 %)**	**Lab (Weightage: 15 %)**
	Tests	**Assignments**	**Lab CE**	**Written exam**	**LSEE: SEE**
	50 marks	**25 Marks**	**25 Marks**	**70 Marks**	**30 Marks**
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments, Laboratory instruction
2.	Understanding	Class room lectures, Assignments, Laboratory instructions and experiments
3.	Critical Skills	Class room lectures, Assignments
4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	Laboratory Work
7.	Group Work	Laboratory Work
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination, Laboratory work
10.	Verbal Communication Skills	Laboratory work
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination, Laboratory
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Millman and Halkias, 2001, Integrated Electronics, Tata McGraw-HillEducation
3. Robert Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 7th Ed. Prentice Hall
4. Dale R. Patrick, 1989, Electricity and Electronics Laboratory, The Goodheart-willcox Company Inc, Illinois

b. Recommended Reading

1. Albert Malvino, 2006, Electronic Principles, Tata McGraw - Hill Education
2. Donald L. Shilling & Charles Belowl, 1968, Electronic Circuits, New York: McGraw-Hill
3. Tocci R J and Widmer N S, 2001, Digital Systems – Principles and Applications, 8th Ed., Pearson Education India, New Delhi
4. Cooper and Helfrick, 1996, Modern Electronic Instrumentation and Measuring Techniques, 4th print Prentice Hall of India, New Delhi

5. H S Kalsi, 2007, Electronic Instrumentation, TMH, 2nd Edition
6. R A Gaikwad, 2001, Op-Amps and Linear Integrated Circuits, PHI, 4th edition
7. Millman and Grabel, 1999, Microelectronics, 2nd Ed. Tata McGraw-Hill
8. Louis R. Nardizzi, 1973, Basic circuits and electronics experiments, Van Nostrand
9. George B. Rutkowski, 1984, Basic electricity for electronics, Bobbs-Merrill Educational Pub.
10. Russell L. Meade, 2003, Foundations of Electronics: Circuits and Devices,Delmar learning, a division of Thomson learning, Inc.

c. Magazines and Journals

1. Electronics For You
2. IEEE Transaction on Circuits and System I and II

d. Websites

1. http://www.electronics-lab.com
2. http://www.labmanager.com
3. http://electronicsforu.com
4. http://www.lifescienceleader.com

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm MultiSim software
2. Analog trainer kit
3. Digital trainer kit
4. Discrete electronic components

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Course Specifications: Engineering Drawing

Course Title	Engineering Drawing
Course Code	MEF103A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course deals with graphical representation of geometrical entities in various views for visualization and communication. The students will be taught orthographic and isometric projection of points, lines, planes and solids. The students will be taught sections and development of solids. The students will be equipped to visualize and apply principles of orthographic projection to given application. The students will also be trained to use CAD tool to carry out these geometric projections.

2. Course Size and Credits

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:1
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical and Manufacturing Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe the conventions used in projections of geometric entities and interpret thesame

CO-2. Draw orthographic projections for the geometric entities in specified positions

CO-3. Develop lateral surfaces of un-sectioned and sectioned regular solids

CO-4. Develop orthographic projections for given applications

CO-5. Draw isometric projections for the solids and their combinations

CO-6. Demonstrate competency in using CAD tool for drawing projections of geometric entities

4. Course Contents

Unit 1 (Introduction to Engineering Drawing and CAD Tool): Drawing Instruments and their uses, BIS conventions and specifications, Dimensioning and Significance of Lettering, Graphical User Interface (GUI), Co-ordinate system and reference planes. Definitions of Horizontal Plane (HP), Vertical Plane (VP), Right Profile Plane (RPP) & Left Profile Plane (LPP). Creation of 2D/3D environment. Selection of drawing size and scale. Creation of geometric entities and text.

Modification and editing of geometric entities. Dimensioning, line conventions and material conventions

Unit 2 (Orthographic Projections- Points and Lines): Definitions - Planes of projection, reference line and conventions employed. Projections of points in all the four quadrants, Projections of straightlines (located in First quadrant, first angle projection), True and apparent lengths, True and apparentinclinations to reference planes (simple problems).

Unit 3 (Orthographic Projections - Planes (First Angle Projection): Definitions–projections of plane surfaces–triangle, square, rectangle, pentagon, hexagon and circle. Planes in different positions bychange of position method only.

Unit 4 (Orthographic Projections – Solids (First Angle Projection): Definitions – Projections of solids– cube, prisms, cylinder, pyramids, cones and tetrahedron in different positions.

Unit 5 (Orthographic Projections – Section of Solids and Development of Surfaces (First Angle Projection): Section planes, Sections, Section views, Apparent shapes and True shapes of sections ofright regular prisms, pyramids, cylinders and cones resting in simple positions.

Unit 6 (Isometric Projections using Isometric Scale) : Section planes, Sections, Section views, Apparent shapes and True shapes of sections of right regular prisms, pyramids, cylinders and cones resting in simple positions. Application of Projection of points and lines to given situation.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3	2								1			3		1
CO-3	3	2								1			3		1
CO-4	3	2								1			3		1
CO-5	3	2								1			3		1
CO-6					2									2	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop /	00	

Kitchen		
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	**CE (Weightage: 50 %)**			**SEE (Weightage: 35 %)**	**Lab (Weightage: 15 %)**
	Tests	**Assignments**	**Lab CE**	**Written exam**	**LSEE: SEE**
	50 marks	**25 Marks**	**25 Marks**	**70 Marks**	**30 Marks**
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignments

2.	Understanding	Classroom lectures, Assignments
3.	Critical Skills	Classroom lectures, Assignments
4.	Analytical Skills	Classroom lectures, Assignments
5.	Problem Solving Skills	Classroom lectures, Assignments
6.	Practical Skills	Assignment
7.	Group Work	Assignments
8.	Self-Learning	Assignments
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	Assignment
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. K. R. Gopalakrishna, 2005, Engineering Graphics, 32nd Edition, ShubhashPublishers

b. Recommended Reading

1. W. J. Luzadder, 2006, Fundamentals of Engineering Drawing, 11th Edition,Prentice Hall India
2. N. D. Bhatt and V. M. Panchal, 2006, Engineering Drawing, 49th Edition,Charotar Publishing House
3. CAD Tool Users Manuals

c. Websites

1. http://nptel.ac.in

d. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Constitution, Human Rights and Law

Course Title	Constitution, Human Rights and Law
Course Code	LAN101A
Course Type	Ability Enhancement Compulsory Course
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course aims at enabling students understand the key principles of Indian Constitution, Human Rights and Law. The course facilitates the understanding of the framework of Indian constitution and the judicial and the legal systems that guides Indian citizens. It aims at building awareness about the application of Human Right principles and Law. It allows students to work towards the formulating realistic solutions for protection of human rights.

2. Course Size and Credits

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	School of Law
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain the key principles of the Indian Constitution
CO-2. Explain Indian legal system and judicial structure that govern the citizens
CO-3. Discuss UN Declaration of Human Rights
CO-4. Discuss the scope and application of Human Rights Principles and Law
CO-5. Suggest strategies for protection of human rights and resolving legal issues in compliancewith applicable laws

4. Course Contents

Unit 1 (Constitution of India): The framework of Constitution of India, Constituent Assembly, The Constitution and the government, The constitution and the judiciary, The constitution and the legislature.

Unit 2 (Introduction to Law): Indian Legal System and Judicial Structure, Liability under the Law, Issues relating to Good Corporate Governance, Company Law.

Unit 3 (Concept of Human Rights and Duties): Inherent, inalienable, universal, indivisible, values, dignity, liberty, equality, justice, unity in diversity, classification of rights, classification of duties, correlation of rights and duties, need for balance between rights and duties, freedom and responsibility.

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Unit 4 (International Human Rights Standards and UN): Universal declaration of human rights 1948, international covenant on civil and political rights 1966, international covenant on economic, social and cultural rights 1966, UN system and human rights, convention on elimination of all forms of racial discrimination 1965, convention on elimination of all forms of discrimination against women 1979, convention on the rights of the child 1989, UN declaration and duties and responsibilities of individuals 1997, UN agencies to monitory compliance such as UN high commission for human rights.

Unit 5 (Contract Law and Disputes): Formation of Contract: offer and acceptance, Terms of Contract: avoidance, representation, illegality, Breach of Contract and Remedies, Industrial Disputes Act, Negligence, Trespass and Breach of Statutory Duty, Litigation, Arbitration, JudicialRemedies.

Unit 6 (Intellectual Property Law): Copyright, Protection and Infringement of Copyright, Trade Marks, Protection of Trade Marks and Passing-off, Patents, Ownership and Protection of Patents, Product Liability, Government Schemes for IPR Protection.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3									2			3		2
CO-4	3	2											3		
CO-5										3					3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		0
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		0
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	

6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Face to face lectures
2.	Understanding	Face to face lectures, group discussions
3.	Critical Skills	
4.	Analytical Skills	Face to face lectures, activities, group discussions, assignments
5.	Problem Solving Skills	

6.	Practical Skills	Face to face lectures, activities, group discussions, course work
7.	Group Work	Course work, practice, assignment, group discussion

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8.	Self-Learning	Course work, practice, assignment, group discussion
9.	Written Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
10.	Verbal Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
11.	Presentation Skills	
12.	Behavioral Skills	Course work, practice, assignment, group discussion, presentation practice, role plays
13.	Information Management	Assignment
14.	Personal Management	Face to face lectures
15.	Leadership Skills	Face to face lectures, group discussions

9. Course Resources

a. Essential Reading

1. Course notes
2. Tulsian, PC. (2008) Business Law, Tata McGraw Hill, New Delhi
3. Donnelly, J. (1998) International Human Rights, 2nd edn, Westview Press

b. Recommended Reading

1. Gulshan , S. S and Kapoor, G. K. (2005) Business Law including Corporate Laws,New Age International (P) Ltd. Publishers, New Delhi
2. Perry, M. (1998) The Idea of Human Rights, Oxford University Press
3. K Swamyraj (2017), Law of Contract (General Principles), God's GracePublication, New Delhi
4. D D Basu (1983), Constitutional Law of India, Lexis Nexis ButterworthsPublication, Nagpur
5. Introduction to Intellectual Property Theory and Practice (1997), WorldIntellectual Property Organisation, Geneva
6. Smith, R. (2007) Textbook on international human rights 3rd edn, OxfordUniversity Press

c. Magazines and Journals

d. Websites

1. http://industrialrelations.naukrihub.com/industrial-relation-policy.htm
2. http://labour.nic.in/
3. http://whitepapers.businessweek.com/tlist/Legal-Environment.html
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

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Bangalore

Course Specifications: Engineering Mathematics - 2

Course Title	Engineering Mathematics - 2
Course Code	MTB102A
Course Type	Core Theory
Department	Applicable for all programmes
Faculty	Engineering and Technology

1. Course Summary

This course deals with analytical solutions of ordinary differential equations and Laplace transform. Students are taught the concepts of fundamentals of ordinary differential equations and Laplace transform. The solution procedures for certain standard forms of ordinary differential equations are illustrated. The role, relevance of ordinary differential equations in modelling some of the real world problems are emphasized and this course also covers the underlying principles and applications of transform techniques in various engineering disciplines.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe the fundamentals of ordinary differential equations and Laplace transform

CO-2. Solve standard forms of ordinary differential equations

CO-3. Solve simple problems in ordinary differential equations and Laplace transform

CO-4. Model real world problems using ordinary differential equations and solve complex problems associated with ordinary differential equations using Laplace transform

CO-5. Apply Laplace transform in solving complex real world engineering problems

4. Course Contents

Unit 1 (First Order Differential Equation): First order differential equations - Introduction, basic concepts and geometrical meaning. Separable, linear and exact differential equations. Integrating factors and transformations. Applications of first order ordinary differential equations: orthogonal trajectories, growth/decay problems and mixture problems

Unit 2 (Higher Order Differential Equation): Introduction, initial and boundary value problems. Linearhomogenous/nonhomogeneous differential equations with constant coefficients, method of undetermined coefficients and variation of parameters. Cauchy-Euler equations. Application of second order linear differential equations with constant coefficients, mass-spring-dashpot system, electric circuits. System of linear differential equations of first order, solutions by matrix method.

Unit 3 (Laplace Transform): Definition, properties and theorems, transform of derivatives, integrals, periodic functions, unit step function, Dirac's delta function and time shifting property. Inverse Laplacetransform, convolution theorem, solution of initial value problems

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2							1			3		1
CO-2	2	3	2							1			3		1
CO-3	3	3	1							1			3		1
CO-4	3	3	2	2	2					1			3	2	1
CO-5	3	3	2	2	2					1			3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the followingTable.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. Course Resources

a. Essential Reading

5. Glyn James, 2016, Advanced Modern Engineering Mathematics, 4th edition , Pearson Dennis Zill, 2012,
6. A First Course in Differential Equations, 10th edition, Massachusetts, Brooks/Cole
7. Shepley Ross, 2007, Introduction to Ordinary Differential Equations, 4th edition, New York, John Wiley & sons

b. Recommended Reading

1. George Simmons, 2017, Differential Equations with Applications and HistoricalNotes, 2nd edition, New Jersey, McGraw Hill
2. Dennis Zill and Warren Wright, 2011, Advanced Engineering Mathematics, 4thedition, Jones and Bartlet
3. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, tenth edition, JohnWiley & Sons Inc.

c. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

d. Other Electronic Resources

1. https://www.khanacademy.org/
2. tutorial.math.lamar.edu/

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Course Specifications: Engineering Chemistry and Laboratory

Course Title	Engineering Chemistry and Laboratory
Course Code	CYB104A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This subject aims at enhancing the basic understanding of chemistry with reference to engineering systems and to train students to perform quantitative analysis related to Engineering Chemistry.
This subject deals with topics on electrochemistry, energy stage devices, fuels, chemical kinetics, corrosion science, metal finishing, polymers and nanomaterials.
Students are trained to determine physical and chemical properties of a given sample experimentally. They are trained to analyze the results and infer appropriate conclusions basedon concepts of Engineering Chemistry.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Chemistry
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain the basic concepts of electrochemistry, conversion of chemical energy into electrical energy, theory of corrosion and principles of metal finishing
CO-2. Differentiate renewable - nonrenewable fuels, primary - secondary electrodes & primary - secondary batteries, batteries - fuel cells, electroplating – electrolessplating, thermosetting – thermoplastic polymers and dry corrosion - wet corrosion
CO-3. Discuss the reaction chemistry and stoichiometry of combustion of fuels, remedial measures to control oxides of nitrogen, sulphur and carbon, polymerization – methods, mechanism, preparation, properties and applications of some polymers, concepts of nano science and nanotechnology
CO-4. Identify the types of corrosion and methods to prevent corrosion, suitable polymers and nanocomposite materials for engineering applications
CO-5. Derive kinetic rate equations for various chemical systems and equation for electromotive force
CO-6. Analyze the suitability of polymers & composites for various applications and solve problems related to storage devices, chemical kinetics, electro chemistry, corrosion and metal finishing
CO-7. Plan the experimental set up, conduct experiments, calculate and plot the graphs to obtain results, and write a laboratory report as per the prescribed format

4. **Course Contents**

Unit 1 Electrochemistry: Electrochemical cell, Electrode Potential and EMF. Construction of Galvanic cell, Types of Electrodes. Numerical on Electrode Potential of cell using Nernst equation. Construction and working of reference electrodes: calomel and silver-silver chloride electrode. Construction, working and application of Ion-selective electrode: Glass electrode. Determination of pH using glass electrode

Unit 2 Storage and Conversion devices – Batteries: Storage devices – Batteries: Primary batteries, Secondary batteries, reserve batteries and super capacitors. Construction, working and application of dry cell, lead acid, Nickel-Cadmium, Nickel-Metal hydride, Zinc –Air, Lithium-ion batteries, Lithium polymer batteries.
Conversion devices: Fuel cells, Construction, working and application of: Hydrogen-Oxygen, Methanol-Oxygen cells.

Unit 3 Corrosion and its Control: Types of corrosion. Electrochemical theory of corrosion. Factors affecting, Corrosion control: Metal coating, cathodic protection, organic coating, corrosion-inhibitors.

Unit 4 Metal Finishing: Technological importance of metal finishing, Polarization and factors influencing polarization, Principle of electroplating, factors affecting electrodeposition, Electroplating of Chromium and Gold. Electro-less Plating of Copper and Nickel.

Unit 5 Chemical Kinetics: Order of Reactions, Derivation of second, third, consecutive reactions, rate equations, Steady State Concept, numerical problems with suitable examples of different kinds of reactions.

Unit 6 Combustion Chemistry: Introduction to Fuels, types and classification, Sources of Fuels, Characteristics of a good fuel, Proximate and ultimate analysis, Petroleum cracking, Mechanismof Knocking and its effect, Anti-knocking agents, Octane and Cetane numbers, Functioning of Catalytic converter, Introduction to Biofuels, Flue gases and control measures.

Unit 7 Polymers and polymerization: Introduction & Classification of polymers, Addition, condensation and co- ordination polymerizations, mechanism of free radical addition polymerization with ethylene as example, Techniques of polymerization (Bulk, Solution, suspension, emulsion), Tg, factors affecting Tg, effect of structure on properties of polymers, fundamentals of biodegradable polymers, preparation, properties and technical applications of thermoplastics (PVC, PVA, Teflon), thermosets (PF, UF), elastomers (natural rubber, SBR) & adhesives (epoxy and acrylics) Introduction to polymeric composites.

Unit 8 Introduction to nanoscience and nanotechnology: Basic concepts of Nanoscience and Nanotechnology – Graphene – Carbon nanotubes – Material processing by top down and down top synthesis; chemical vapor deposition and physical vapor deposition– Potential uses of nanomaterials in electronics, robotics, computers, sensors, vehicles and transportation – Medical applications of nanomaterials.

Unit 9 – (Lab Experiments)	
1	Determination of Viscosity Coefficient of a given liquid using Ostwald's Viscometer
2	Conductometric estimation of an acid using standard NaOH solution

3	Determination of pKa of the given weak acid using Glass electrode-Ag/AgCl electrode assembly
4	Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution
5	Colorimetric estimation of Copper
6	Determination of total hardness of a given water sample
7	Determination of percentage of Cu from the given brass sample
8	Determination of percentage of Fe in the rust solution by external indicator Method
9	Determination of first order reaction constant for acid hydrolysis of ethyl acetate
10	Electroplating of copper*
11	Determination of composition of brass alloy using UV-Vis spectroscope*
12	Measurement of voltage in a hydrogen-oxygen fuel cell*
13	Preparation of printed circuit board*
14	Construction and operation of lead acid battery cell*
15	Determination of empirical formula of a fuel using exhaust gas analyzer*

* Demo experiments

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2						3								3	
CO-3							3							3	
CO-4			3										3		
CO-5							1							1	
CO-6		3		2						3			3	2	3
CO-7	3	2		3			2		1	3			3	3	3

3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programmes. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3, LSC4 or LSC5), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	**CE (Weightage: 50 %)**			**SEE (Weightage: 35 %)**	**Lab (Weightage: 15 %)**
	Tests	**Assignments**	**Lab CE**	**Written exam**	**LSEE: SEE**
	50 marks	**25 Marks**	**25 Marks**	**70 Marks**	**30 Marks**
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					
CO-7					
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Gadag, R.V. and Nityananda Shetty A., (2010), Engineering Chemistry, Second Edition, New Delhi, I.K. International Publishing House
3. O.G. Palanna, (2011), Engineering Chemistry, New Delhi, Tata McGraw Hill Education Pvt Ltd.
4. Gurudeep Raj, (2014), Advanced Physical Chemistry, Meerut-Uttar Pradesh, Krishnan Prakashana
5. Pradeep. T, (2012) "A Text Book of Nanoscience and Nanotechnology", NewDelhi, Tata McGraw Hill Company Ltd.

b. Recommended Reading

1. Pletcher, D. and Walsh, F.C., (1993), Industrial Electrochemistry, Second edition, UK, Blackie Academic and Professional
2. Kuriacose, J.C. & Rajaram, J., (1998), Chemistry in Engineering & Technology (Voll & II), Third reprint, New Delhi, Tata McGrahill Company
3. C. N. R. Rao, Achim Muller and A.K. Cheetham, (2004), The Chemistry of Nanomaterials, Vol I & II, Weinheim, Wiley VCH.

c. Other Electronic Resources

1. http://nptel.ac.in/
2. Electronic resources on the subject area are available on MSRUAS library

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Course Specifications: Elements of Mechanical Engineering and Workshop Practice

Course Title	Elements of Mechanical Engineering and Workshop Practice
Course Code	MEF104A
Course Type	Core Theory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course is aimed at preparing the students to understand the concepts and underlying principles of mechanical engineering. The students are taught various types of energy sources, power generation, energy conversion methods and types of power plants. Students are taught the working of IC engines, refrigeration and air-conditioning and power transmission elements. Students are also exposed to basic operations and applications of machine tools.

2. Course Size and Credits

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:1
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical and Manufacturing Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Demonstrate the understanding on Classification of energy sources, energy conversion systems, mechanical power transmission systems, machine tools and processes
CO-2. Describe various energy conversion systems, mechanical power transmission systems and machine tools
CO-3. Explain the working principle of refrigeration systems, biomass conversion technologies and machining operations
CO-4. Solve numerical problems on IC engines and mechanical power transmission systems
CO-5. Apply principles of energy conversion systems, power transmission systems, machining processes and mechanical joints to practical applications

4. Course Contents

Unit 1 (Energy Sources and its Conversion Devices): Energy sources and their classification, Fuels and their properties. Bio-mass energy, OTEC, Solar energy, Wind energy, Geo-thermal energy, Tidal energy, Nuclear Energy. Demonstration of Gas Turbine

Unit 2 (Boilers and Accessories): Steam boilers – classification, Lancashire boiler, Babcock and Wilcox boiler; working and function of boiler mountings and accessories. Demonstration of Steam Turbine

Unit 3 (Hydraulic Pumps and IC engines): Classification, Principles and operations of Reciprocating and rotary types of pumps and compressors.
Internal Combustion Engines: Classification of IC Engines, engines components, 2 and 4–Stroke Petrol and diesel engines, P-V diagrams for Otto and Diesel cycles, IC engine performance-numerical on IC engines, electric and Hybrid vehicles. Demonstration of Pumps, Blower Compressors and Multi-cylinder Engine.

Unit 4 (Refrigeration and Air Conditioning): Properties of refrigerants, Performance of Refrigeration System - Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, Unit of Refrigeration, Energy Efficiency Ratio (EER). Principle and working of vapour compression refrigeration, vapour absorption refrigeration, comparison of vapour compression and vapour absorption refrigeration. Principles and applications of air conditioners, Room air conditioner, automotive air conditioning system

Unit 5 (Mechanical Power Transmission): Belt Drives - Classification and applications, Length of belt, Velocity ratio, Creep and slip, Idler pulley, stepped pulley and fast and loose pulley, belt and pulley construction. Demonstration of Open and Cross Belt drive. Applications of chain drive and rope drives. Gear Drives: Definitions, Terminology, types and uses, Gear Drives and Gear Trains – Simple problems on gear drives. Demonstration of Simple and Compound Gear Trains. Importance of machining and machine tools

Unit 6 (Machine Tools and Mechanical Joints): Lathe - Principle of working of a Centre Lathe, Parts of a lathe, Lathe Operations. Drilling Machine – Principle of working and classification of drilling machines, types of drilling machines, drilling operations. Demonstration of working of Lathe and drilling machines along with different operations performed. Mechanical Joints: Temporary and permanent fasteners- Threaded fasteners, Riveted joints, welded joints, Knuckle joint, cotter and pin joints, couplings. Demonstration of Fitting operations, Sheet Metal operations, Arc Welding, Fasteners and Couplings.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3												3		
CO-4		3											3		
CO-5		3											3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	

3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		20
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	30	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the followingTable.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. V. K. Manglik, 2013, Elements of Mechanical Engineering, PHI Learning
3. K. R. Gopalakrishna, 2008, Elements of Mechanical Engineering, Subhash Publishers

b. Recommended Reading

1. G.D. Gokak, J.K. Kittur, 2014, Elements of Mechanical Engineering, Wiley publications
2. G. S. Sawhney, 2003, Fundamental of Mechanical Engineering, Prentice Hallof India Publication
3. S. Trymbaka Murthy, 2006, A Text Book of Elements of Mechanical Engineering, 3rd Revised Edition, I .K. International Publishing House Pvt. Ltd.
4. K. P. Roy and S. K. Hajra Chaudhary, 2005, Elements of Mechanical Engineering, Media Promoters and Publishers Pvt. Ltd.

c. Magazines and Journals

1. ASME Mechanical Engineering Magazine
2. Machine Tools

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. www.asme.org

e. Other Electronic Resources

1. Electronic resources on the course area are available on RUAS library

Course Specifications: Elements of Electrical Engineering and Laboratory

Course Title	Elements of Electrical Engineering and Laboratory
Course Code	EEF105A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course deals with basic principles and concepts of electric and magnetic circuits. Students are taught construction, principle of operation, working, characteristics of DC machines, transformers and AC rotating machines. They are introduced to fractional-kW motors, special purpose machines and facilitated to understand measuring instruments, domestic wiring and earthing techniques. Basic electrical laboratory deals with practical applications of circuits and their theoretical concepts.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. State and explain various laws of electric circuits, magnetic circuits and their significance, phasor diagrams for electrical elements
CO-2. Explain construction, principle of operation, working and characteristics of DC machines, transformers, AC rotating machines and their applications
CO-3. Derive equations for electrical circuits, magnetic circuits and performance of various AC and DC machines
CO-4. Solve problems on electric circuits, magnetic circuits, DC machines, transformersand AC rotating machines
CO-5. Conduct experiments as per the standard procedures and tabulate/calculate/plot the measured values
CO-6. Interpret and compare with standard results, and draw conclusions and write report as per the prescribed format

4. Course Contents

Unit 1 (Circuit Analysis Technique-I): DC Fundamentals: Circuit elements, voltage and current division, Ohm's law and Kirchhoff's laws, mesh analysis, nodal analysis, source transformations, application of star delta transformation, Thevenin's theorem, maximum power transfer theorem, superposition theorem.

Unit 2 (Circuit Analysis Technique-II): A.C. Fundamentals: Sinusoidal voltage and currents, period, frequency, instantaneous, peak, average, r.m.s. values, peak factor and form factor, phase difference, lagging, leading and in phase quantities. Simple R, L and C circuits.

Unit 3 (Magnetic Circuits): Magnetic effect of electrical current, cross and dot convention, right hand thumb rule and cork screw rule, Fleming's right hand rule, Fleming's left hand rule, Faraday's law of electromagnetic induction, statically and dynamically induced EMF's, concepts of m.m.f, flux, flux density, reluctance, permeability and field strength, basic analogy between electric and magnetic circuits.

Unit 4 (DC Machines): Constructional details, working principle and methods of excitation of DC machine as a generator and a motor. EMF equation of generator, relation between induced EMF and terminal voltage with brush contact drop, back EMF, torque equation of a DC motor.

Unit 5 (Transformers and AC Rotating Machines): Single Phase Transformers: Necessity of transformer, Constructional Details (core and shell types), Principle of operation, Ideal Transformer and Practical Transformer. EMF equation, Losses, Transformer Test, Circuit Model of Transformer, Determination of Parameters of Circuit Model of Transformer, Impedance shifting, Efficiency and Regulation Calculations
Three phase induction machine: Constructional details, principle of operation, slip and rotor frequency.

Unit 6 (Domestic Wiring): Domestic wiring, concealed conduit wiring, two-way and three-way control

Unit 7 (Laboratory): List of Experiments

No.	Course Content for Laboratory
1	Verification of KVL and KCL for DC circuits
2	Verification of superposition theorem
3	Verification of Thevenin's theorem
4	Verification of maximum power transfer theorem
5	Verification of mesh analysis
6	Verification of node analysis
7	Determination of relationship between phase and line voltages; Phase and line currents in a three phase system
8	Determination of efficiency of a single phase transformer
9	Analysis of load characteristics of DC shunt motor
10	Wiring of two-way and three-way switching of lamp

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2				2	2			1		1	3	2	1
CO-2	3	2				2	2					1	3	2	1
CO-3	3	2	2									1	3		1
CO-4	3	3	2		2				1	1		1	3	2	1
CO-5	3	3	3	2	2	2			1	1	1	1	3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		30
1. Course Laboratory	20	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3 and LSC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	**CE (Weightage: 50 %)**			**SEE (Weightage: 35 %)**	**Lab (Weightage: 15 %)**
	Tests	**Assignments**	**Lab CE**	**Written exam**	**LSEE: SEE**
	50 marks	**25 Marks**	**25 Marks**	**70 Marks**	**30 Marks**
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shallprovide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Edward Hughes, 2011, Electrical and Electronics Technology, 10th edition,Dorling Kindersley India Pvt. Ltd.
3. Del Toro V. 2008, Electrical Engineering Fundamentals, PHI

b. Recommended Reading

1. Mittle V. and Arvind Mittle, 2007, Basic Electrical and Electronics Engineering,Tata McGraw Hill, New Delhi
2. Delton Horn T. 1993, Basic Electricity and Electronics, McGraw-Hill Limited, Europe

c. Magazines and Journals

1. IEEE Circuits and Designs magazine

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. MULTISIM/ PROTEUS
2.

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Course Specifications: Elements of Computer Science and Engineering

Course Title	Elements of Computer Science and Engineering and Laboratory
Course Code	CSF106A
Course Type	Core Theory and laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course is intended to provide an understanding of the elements of computer science and engineering and development of computer programs using algorithmic and programming constructs, for students across streams. Elements and methods of computer science and engineering and their applications to engineering computational problems are discussed using illustrative examples. Students are taught the methodology of solving computational problems algorithmically, programming concepts and constructs, basic algorithms and data structures. They are also exposed to the practice of software development, modern computing systems and their scope for engineering applications.

2. Course Size and Credits

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe the elements and methodology of Computer Science and Engineering
CO-2. Explain the basic principles and techniques of algorithms and programming
CO-3. Select appropriate approach to solve a computational problem
CO-4. Design an algorithmic solution and draw a flow chart of the solution
CO-5. Develop computer programs for moderately complex problems
CO-6. Test and validate developed computer programs

4. Course Contents

Unit 1 (Introduction): Computers and other computing devices, interface between Computer Science and Engineering (CSE) and other disciplines, idea of computing, nature and purpose of CSE, software and computer programs, practice of CSE. Relationship between data, information and knowledge.

Unit 2 (Problem Solving using Computers): Algorithmic problem solving. Flowcharts: symbols and meaning. Drawing flowcharts for simple problems. Fundamental algorithms, efficiency. Example of algorithms in practice: Illustration of algorithms for numerical computation, simulation and data processing in engineering domains. Lab Exercises on Problem Solving Using Computers.

Unit 3 (Building Blocks of Computer Programs): Programming languages and process of compiling and program execution. Data representation and storage. Python programming language, IDEs and Workbooks. Data types, variables and keywords. Program structure. Simple data manipulation and logical statements, lists, tuples, sets and dictionaries, conditional and looping control statements, functions, nested expressions, recursion. Plotting and other utility libraries. Lab Exercises on Building Blocks of Computers.

Unit 4 (Elements of Computer Programming): Elements of good programming style, decomposing problems, moving from algorithm to code, random number generation, testing and validation of programs. Lab Exercises on Problem Solving Using random number generation.

Unit 5 (Basic Algorithms and Data Structures): Iterative and recursive algorithms, algorithms for search, sorting algorithms, idea of a data structure, basic data structures and algorithms, and their use. Lab Exercises on Problem Solving Using Iterative and recursive algorithms.

Unit 6 (Algorithm Design): Recursion, Brute force, Divide and conquer, Greedy approaches. Introduction to Backtracking and Dynamic programming.

Unit 7 (Modern Computing Systems): Software development process, operating systems, network of computers, distributed computing, high performance computing, Internet and Web technology, cloud computing.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	3	2	2	2		1			1	2	3	2	2
CO-2	2	1	3	2	2	2		1			1	2	3	2	2
CO-3	2	1	3	2	2	2		1			1	2	3	2	2
CO-4	2	1	3	2	2	2		1			1	2	3	2	2
CO-5	2	1	3	2	2	2		1			1	2	3	2	2
CO-6	2	1	3	2	2	2		1			1	2	3	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	

3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the followingTable.

Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	**CE (Weightage: 50 %)**			**SEE (Weightage: 35 %)**	**Lab (Weightage: 15 %)**
	Tests	**Assignments**	**Lab CE**	**Written exam**	**LSEE: SEE**
	50 marks	**25 Marks**	**25 Marks**	**70 Marks**	**30 Marks**
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

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8. Achieving Cos

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Dromey, R. G., 1982, How to Solve It by Computer, New Delhi: PearsonEducation.

b. Recommended Reading

1. Downey, A. B., 2016, Think Python: How to think like a Computer Scientist,O'Rielly.
2. Polya, G., 1990, How to Solve It: A New Aspect of Mathematical Method, 2ndedn. New Delhi: Penguin Books.
3. Aho, A. V., Hopcropt, J. E., and Ulman, J. D., 1974, The Design and Analysis ofComputer Algorithms, New Delhi: Pearson Education.

c. Magazines and Journals

1. Quanta Magazine Computer Science Section, http://www.quantamagazine.org/ computer science
2. Dr. Dobb's Journal, http://drdobbs.com/

d. Websites

1. Association of Computing Machinery (ACM), http://www.acm.org/
2. IEEE Computer Society, http://www.computer.org/

e. Other Electronic Resources

1. Electronic resources on the course area available on MSRUAS library
2. Think Python online: http://openbookproject.net/thinkcs/python/english2e/

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Course Specifications: Professional Communication

Course Title	Professional Communication
Course Code	TSN101A
Course Type	Ability Enhancement Compulsory Course
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course aims at equipping students with the skills required for effective communication in professional context. The students will be guided through professional practices of written and oral communication. Students will be sensitized to the importance of professional etiquette. Students willbe taught to apply oral and written communication skills in a given situation.

2. Course Size and Credits

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Directorate of Transferable Skills and Leadership Development
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Apply the concepts of grammar for communication
CO-2. Compose precise paragraphs
CO-3. Demonstrate professional etiquette
CO-4. Demonstrate appropriate verbal and non-verbal communication in the given context
CO-5. Develop professional written document

4. Course Contents

Unit 1 (Grammar for Effective Communication): Sentence formation, sentence types, different parts of speech, adjectives and articles, verbs and preposition, present and past tense, future tense, use of participles in different tenses, usage of tenses, rules of subject verb agreement, Direct and indirect sentences, usage of direct and indirect sentences

Unit 2 (Communication – Verbal: Written): Paragraph Writing: Structure of a paragraph – topic sentence, supporting sentence, conclusion sentence, functions of paragraph, paragraph patterns, paragraph writing principles – coherence, unity, order, length; Précis Writing: Paraphrasing techniques, Usage of appropriate words;

Report Writing: Purpose of report writing, report format, use of language while report writing

Unit 3 (Communication-Nonverbal): Meaning, Nature and importance, Kinesics, Proxemics, Time, Paralanguage, Touching Behavior, Body Language, effects of nonverbal communication on verbal communication

Unit 4 (Professional Etiquette): Etiquette and its importance, types of etiquette - email etiquette, telephone etiquette, conversation; Body language in conversation, tones in conversation, conversation manners, stages of conversation – introduction, feed forward, close, order of introduction, conversation barriers

Unit 5 (Presentation): The importance of presentation skills, various stages of presentation planning
– development of structure and style, interpersonal sensitivity, presentation accessories and equipment, time management during presentation, stages of presentation – introduction, body and conclusion, presentation etiquette

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1										2					2
CO-2										3					3
CO-3									3						3
CO-4									3	3					3
CO-5										3					3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		0
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		0
1. Solving Numerical Problems	00	
Practical Work		04
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	04	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

Others		06
1. Case Study Presentation	02	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	02	
5. Group Discussions	02	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment is presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2), COs are assessed as illustrated in the following Table. Focus of CO's on each Component or Subcomponent of Evaluation:

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Face to face lectures
2.	Understanding	Face to face lectures, group discussions
3.	Critical Skills	--
4.	Analytical Skills	Face to face lectures, activities, , group discussions, assignment
5.	Problem Solving Skills	--

6.	Practical Skills	Face to face lectures, activities, , group discussions, course work
7.	Group Work	Course work, practice, assignment, group discussion
8.	Self-Learning	Course work, practice, assignment, group discussion
9.	Written Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
10.	Verbal Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
11.	Presentation Skills	--
12.	Behavioral Skills	Course work, practice, assignment, group discussion, presentation practice, role plays
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Raman M and Sharma S (2004) Technical Communication: Principles and Practice.New Delhi: Oxford University Press
3. Hory Sankar Mukherjee, (2013), Business Communication, Oxford University Press
4. Kroehnert, Gary (2004), Basic Presentation Skills, Tata McGraw Hill

b. Recommended Reading

1. Sathya Swaroop Debashish and Bhagaban Das, (2014), BusinessCommunication, PHI, New Delhi
2. Young, Dona J (2006) Foundations of Business Communications:
3. An Integrated Approach, Tata McGraw Hill
4. Kaul, Asha (2007) Effective Business Communication, Prentice Hall India
5. Bienvenu, Sherron (2008) The Presentation Skills Workshop, Prentice Hall
6. KavitaTyagi and Padma Misra (2011) Professional Communication, PHI LearningPrivate Limited, New Delhi

c. Magazines and Journals

d. Websites

1. www.myenglishpages.com
2. www.britishcouncil.com
3. www.englishmagazine.com
4. www.justenglishmagazine.com

e. Other Electronic Resources

1. Electronic resources on the course area are available on RUAS library

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Course Specifications: Engineering Mathematics - 3

Course Title	Engineering Mathematics - 3
Course Code	MTF201A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with vector calculus, various transform techniques in the context of engineering problems. The rudimentary principles and important theorems in vector calculus are taught in this course. The assumptions, principles and distinguishing features of Fourier series, Fourier transform and Laplace transform are emphasized. This course also covers the underlying principles and applications of transform techniques in various engineering disciplines. This course also aims at solving engineering problems associated with Fourier series, Fourier transform and Laplace transform methods using MATLAB.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. State and explain the important theorems in Fourier series, transforms and vector integral calculus
CO-2. Solve simple problems in Fourier series, transforms and vector calculus
CO-3. Apply Fourier series, transforms and vector calculus in solving complex real worldengineering problems
CO-4. Implement the programs to solve system of linear equations and non-linear equationsof single variable using MATLAB
CO-5. Apply interpolation and numerical integration method in analyzing some real world problems

4. Course Contents

Unit 1 (Fourier Series and Fourier Transform): Periodic functions, Dirichlet's conditions for convergence of Fourier series, Fourier series for a periodic function of period T, half range Fourier series, complex Fourier series. Fourier Transform - Definition, Fourier transform of elementary functions, properties. Inverse Fourier transform, solution of initial value problems.

Unit 2 (Vector Calculus): Review of vector algebra, vector and scalar fields, derivatives of vector valued functions, curves, tangents, arc length. Gradient of a scalar field, directional derivatives, divergence

and curl of a vector field. Polar, Cylindrical and Spherical coordinates systems. Line integral, double integral and triple integral, Green's theorem, Stokes' theorem, Gauss divergence theorem.

Unit 3 (MATLAB): Introduction to MATLAB, Basic algebraic and matrix operations, built-in and command line functions, Plots Scripts and functions. Interpolation - Lagrange interpolation, Newton's divided difference interpolation, Newton-Raphson method and Numerical solution of system of linear equations by Gauss Seidel method, MATLAB function for real Fourier series, complex Fourier series and harmonic series, Newton-Cotes' quadrature, trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules, and Gaussian quadrature.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		2					1	1			3	2	1
CO-2	3	3											3		
CO-3	3	3											3		
CO-4	3	3	3		2				1	1			3	2	1
CO-5	3	3	3		2				1	1			3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		15
1. Course Laboratory		
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10

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Total Duration in Hours	70

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			Component2: SEE (50% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Mid Term	Assignment	Assignment	100 Marks
Maximum Marks ▶	25	25	25	
CO-1	▯			▯
CO-2	▯			▯
CO-3	▯			▯
CO-4		▯	▯	▯
CO-5		▯	▯	▯
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment

14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Glyn James, 2016, Advanced Modern Engineering Mathematics, 4th edition, Pearson
2. Dennis Zill and Warren Wright, 2011, Advanced Engineering Mathematics, 4thedition, Jones and Bartlet
3. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, tenth edition, JohnWiley & Sons Inc.

b. Recommended Reading

1. L. Chanparro, 2010, Signals and Systems using MATLAB, Academic Press
2. S.D. Stearns and D. R. Hush, 2011, Digital Signal Processing with Examplesin MATLAB, CRC Press

c. Magazines and Journals

d. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. https://www.khanacademy.org/
2. tutorial.math.lamar.edu/

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Course Specifications: Signals and Systems

Course Title	Signals and Systems
Course Code	21EEC201A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with continuous-time and discrete-time signals and systems. Students are taught the various continuous-time and discrete-time signals and systems, the underlying mathematics required for analysis and understanding of signals and systems including Fourier and z-transforms. Students are also taught to perform time and frequency domain analysis of systems including stability and are exposed to software tools for solving signals and systems problems.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe the signals and systems, their classification and perform the basic operations on signals
CO-2. Evaluate the time response of continuous-time and discrete-time systems LTI systemsfor specified inputs and impulse response
CO-3. Compute the Fourier series of periodic signals, Fourier transform of aperiodic signalsand z-transform of discrete-time signals
CO-4. Solve problems on signal generation, signal manipulation, classification of signals and systems
CO-5. Analyse signals and systems in both time and transformed domains
CO-6. Use standard software tools to analyse and perform time and frequency domain analysis of signals and systems

4. Course Contents

Unit 1 (Signals and Systems): Basic definitions, continuous and discrete time signals, transformation of the independent variable, classification of signals, operations on signals, continuous-time and discrete-time systems, classification of systems

Unit 2 (Linear and Time-invariant Systems): Convolution sum and convolution integral, Singularity functions, impulse response of LTI systems, properties of convolution, Causal LTI systems described by differential and difference equations, Solution of differential and difference equations, Block diagram representation.

Unit 3 (Fourier Series Representation of Periodic Signals): The response of LTI systems for complex exponentials, Fourier series representation of continuous time and discrete time periodic signals, Convergence of Fourier series, Properties of continuous time and discrete timeFourier series.

Unit 4 (Continuous–Time Fourier Transform): Sampling Theorem, Reconstruction of signal from its samples and Aliasing Continuous-time Fourier transform, properties of CTFT, CTFT pairs, Systems characterized by linear constant coefficient differential equations.

Unit 5 (Discrete–Time Fourier Transform): Discrete-time Fourier transform, properties of DTFT, DTFT pairs, Systems characterized by linear constant coefficient difference equations.

Unit 6 (The z-Transform): Definition of z-transform, Region of convergence for z-Transforms, Properties of the z-Transform, z-Transform pairs, Inverse z-Transform, Solution of difference equations, Analysis and characterization of LTI systems using z-Transform, System function algebra and block diagram representation, Unilateral z-transform and properties, solving difference equations using unilateral z- transform

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2											3		
CO-2	3	3	1	2	2								3	3	
CO-3	2	3	2	3	3	2							2	3	
CO-4	1	3	2	3	3	2	2						3	3	
CO-5	1	1	2	3	3	3	2						3	3	
CO-6	1	1	3	3	3	3	2						1	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		

1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme

Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the Cos. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), Cos are assessed as illustrated in the following Table.

Focus of Cos on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Mid Term**	**Assignment**	**Assignment**	**100 Marks**
Maximum Marks ▶	**25**	**25**	**25**	
CO-1	X			X
CO-2	X			X
CO-3	X			X
CO-4	X			X
CO-5		X	X	X
CO-6		X	X	X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom Lectures
2.	Understanding	Classroom Lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment

5.	Problem Solving Skills	Assignment and Exam
6.	Practical Skills	Assignment
7.	Group Work	Assignment
8.	Self-Learning	Self-learning
9.	Written Communication Skills	Assignment
10.	Verbal Communication Skills	--
11.	Presentation Skills	Assignment
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course Notes
2. Simon Haykins and Van Veen, 2004, Signals and Systems. John Wiley and Sons

b. Recommended Reading

1. Gordon E. Carlson, 1998, Signal and Linear System Analysis. 2nd Edition. Wiley
2. Alan V. Oppenheim, Alan Willsky and Hamid Nawab, 2007, Signals and Systems. Pearson Education

c. Magazines and Journals

1. IEEE Signal Processing Magazine

d. Websites

1. https://signalprocessingsociety.org

e. Other Electronic Resources

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/

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Course Specifications: Electronic Circuits

Course Title	Electronic Circuits
Course Code	EEC202A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the analysis and design of basic transistor amplifier circuits, feedback amplifiers and large signal amplifiers. The students are taught the methods of biasing transistors and the design of simple amplifier circuits. Mid-band analysis of amplifier circuits using small - signal equivalent circuits are also emphasized in this course. Students are trained to design andanalyse LC oscillators and power amplifiers.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain the principles of biasing the transistors, small and large signal amplifier configurations
CO-2. Describe working principles of feedback amplifiers, power amplifiers andoscillators
CO-3. Solve problems on stability factors, gain, impedance, efficiency, distortion of amplifiers, resonance frequency of oscillators and performance parameters of feedback amplifiers
CO-4. Design transistor biasing circuits and small signal amplifier circuits
CO-5. Analyse the stability aspects of amplifiers, performance of feedback amplifiers
CO-6. Simulate and analyse the designs using standard circuit simulation tool

4. Course Contents

Unit 1 (Transistor Analysis): BJT – Need for biasing – Stability factor - Fixed bias circuit, Load line and quiescent point. Variation of quiescent point due to FE h variation within manufacturers tolerance - Stability factors - Different types of biasing circuits - Method of stabilizing the Q point
- Advantage of Self bias (voltage divider bias) over other types of biasing, Bias compensation – Diode, Thermistor and Sensistor compensations, Principles of biasing the FET. Simulation usingstandard circuit simulation tools.

Unit 2 (Mid-band Analysis of Small Signal Amplifiers): Small-signal equivalent circuit of diode,Small-signal equivalent circuits of transistor amplifier in CE, CC and CB configurations - Midband

analysis of various types of single stage amplifiers to obtain gain, input impedance and output impedance - Miller's theorem - Comparison of CB, CE and CC amplifiers and their uses - Methods of increasing input impedance using Darlington connection and bootstrapping, Analysis of Multistage amplifiers. Simulation using standard circuit simulation tools.

Unit 3 (Frequency Response Of Amplifiers): General shape of frequency response of amplifiers - Definition of cutoff frequencies and bandwidth - Low frequency analysis of amplifiers to obtainlower cutoff frequency Hybrid – equivalent circuit of BJTs - High frequency analysis of BJT amplifiers to obtain upper cutoff frequency – Gain Bandwidth Product - High frequency equivalent circuit of FETs – High frequency analysis of FET amplifiers - Gain-bandwidth product of FETs - General expression for frequency response of multistage amplifiers - Calculation of overall upper and lower cutoff frequencies of multistage amplifiers - Amplifier rise time and sag and their relation to cutoff frequencies.

Unit 4 (Large Signal Amplifiers): Classification of amplifiers, Class A large signal amplifiers, second harmonic distortion, higher order harmonic distortion, transformer-coupled class A audio power amplifier – efficiency of Class A amplifiers. Class B amplifier – efficiency - push-pullamplifier - distortion in amplifiers - complementary-symmetry (Class B) push-pull amplifier, Class C tuned amplifiers, Significance of heat sink.

Unit 5 (Feedback Amplifiers): Block diagram, Loop gain, Gain with feedback, Effects of negative feedback – Sensitivity and de-sensitivity of gain, Cut-off frequencies, distortion, noise, input impedance and output impedance with feedback, Four types of negative feedback connections
– voltage series feedback, voltage shunt feedback, current series feedback and current shunt feedback, Method of identifying feedback topology and feedback factor, Nyquist criterion for stability of feedback amplifiers.

Unit 6 (Oscillators): Classification, Barkhausen Criterion – Mechanism for start of oscillation and stabilization of amplitude, General form of an Oscillator, Analysis of LC oscillators – Hartley, Colpitts, RC oscillators –phase shift – Wien bridge –, Electrical equivalent circuit of Quartz Crystal, Miller and Pierce Crystal oscillators, frequency stability of oscillators.

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3											1	3		1
CO-2	3											1	3		1
CO-3	2	2										1	2		1
CO-4	2	2	1									1	2		1
CO-5	1	2	1									1	2		1
CO-6		2	1									1	2		1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		05
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	

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6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	05	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component2: SEE (50% Weightage**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Mid Term**	**Assignment**	**Assignment**	**100 Marks**
Maximum Marks ▶	**25**	**25**	**25**	
CO-1	X			X
CO-2	X			X
CO-3	X			X
CO-4	X	X	X	X
CO-5		X	X	X
CO-6		X	X	X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignments
2.	Understanding	Classroom lectures, Assignments
3.	Critical Skills	Classroom lectures, Assignments
4.	Analytical Skills	Classroom lectures, Assignments

5.	Problem Solving Skills	Classroom lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment

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8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. **Course Resources**

a. Essential Reading

1. Class Notes
2. J. Millman and C Halkias, 2007, Electronic Devices and Circuits. 2nd Edition. Tata McGraw- Hill

b. Recommended Reading

1. Charles Alexander and Matthew Sadiku, 2004, Fundamentals of ElectricCircuits, McGraw-Hill
2. Richard Jaeger, 1997, Microelectronic Circuit Design, McGraw-Hill
3. John Hayes, 1993, Introduction to Digital Logic Design, Addison Wesley

c. Magazines and Journals

1. IEEE Circuits and Devices Magazine

d. Websites

1. http://www.electronicsforu.com/electronicsforu/lab/

e. Other Electronic Resources

1. MULTISIM/ PROTEUS
2. Data sheets of general-purpose transistors: http://www.farnell.com/datasheets/661741.pdf

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Course Specifications: Network Analysis and Synthesis

Course Title	Network Analysis
Course Code	EEC203A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to present the fundamentals concepts of network analysis and synthesis. Students are taught basic network concepts and network theorems, Two-Port Networks, Elements of Realizability Theory, Synthesis of One-Port Network and Elements of transfer function synthesis.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain fundamentals of electric networks, source and circuit transformation techniques
CO-2. Simplify complex electrical circuits using various circuit theorems
CO-3. Analyze general networks, ladder networks, transient behavior and resonance in electrical circuits
CO-4. Develop relation between various two port network parameters
CO-5. Solve simple network problems
CO-6. Solve complex network problems

4. Course Contents

Unit 1 (Basic Network Concepts): Network analysis, network elements, source transformation and source shifting, star–delta transformation, network equations for DC circuits with independent and dependent sources, conceptsof super node and super mesh, basic concepts of locus diagram.

Unit 2 (Network Theorems): Superposition theorem, Thevenin's theorem, Norton's theorem, Milliman's theorem, maximum power transfer theorem, reciprocity theorem, concept of duality.

Unit 3 (Transient Behavior of Electric Circuits): Steady state and transient response, behavior of circuitelements under switching condition and their representation, evaluation of initial and final conditionsin RL, RC and RLC circuits for DC.Resonant Circuits: Series and parallel resonance.

Unit 4 (Network Functions): Network function for one-port and two-port, relation between port parameters, analysis of ladder and general networks using network function, poles and zeros with restrictions for driving point functionsand transform functions.

Unit 5 (Two-port Parameters): Open circuit, short circuit, transmission and hybrid parameters, relationship between parameters, reciprocity and symmetry conditions, interconnection of two ports.

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												2	1	
CO-2	3												2	1	
CO-3	3	3	3	3	2								3	3	
CO-4	3	3	3	3	2								3	3	
CO-5	2	3	3	2	3								3	3	
CO-6	2	3	3	2	3								3	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

5. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	

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6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment

14.	Personal Management	--
15.	Leadership Skills	--

8. Course Resources

a. Essential Reading

1. Course notes
2. M. E. Van Valkenburg, 2006, Network Analysis, 3rd Edition, PearsonEducation
3. Kuo, F.F. 2006, Network Analysis and Synthesis, 2nd Edition John Wiley & Sons
4. William Hayt and Jack E Kemmerly, 2013, Engineering Circuit Analysis. 8thEdition. McGraw Hill

b. Recommended Reading

1. Ravish R Singh, 2013, Network Analysis and Synthesis, Mumbai, McGraw HillEducation India Private Limited
2. Roy Choudhury, 2006, Networks and systems, 2nd Edition, New AgeInternational
3. N.C.Jagan and C. Lakshminarayana (2006) Network Analysis. B.S. Publications

c. Magazines and Journals

1. Electronics for You' magazine.
2. 'Electronic Design' magazine.

d. Websites

1. https://www.edx.org/
2. https://www.coursera.org/

e. Other Electronic Resources

1. http://nptel.ac.in/

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Course Specifications: Digital Logic Design

Course Title	Digital Logic Design
Course Code	21EEC204A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to create a strong foundation of Digital Electronics. The students are taught the basic components of digital systems and the processes of their implementation. The students are also taught Boolean algebra, logic gates, basics of memories, and implementationof combinational and sequential digital circuits using logic gates. Students are trained to employthe principles of digital electronics to implement digital design for the given problem.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain basic concepts of digital electronics such as Boolean algebra, logic functions
CO-2. Describe and Classify different types of digital circuit implementations
CO-3. Solve problems on logic design and logic minimization, and also incorporate them in software tools
CO-4. Analyze a practical problem and develop a logic design to solve the problem
CO-5. Apply digital design concepts for complex digital circuits

4. Course Contents

Unit 1 (Introduction and Boolean Algebra): Introduction to digital electronics, Boolean algebra, Boolean Operations and Expressions, Laws and Rules of Boolean Algebra, DeMorgan's Theorem, Boolean Analysis of Logic Circuits, Simplification using Boolean Algebra, Standard Forms of Boolean Expressions, Boolean Expressions and Truth Tables, 2,3,4 and 5 variable Karnaugh Maps, SOP and POS Minimization using Karnaugh Maps

Unit 2 (Combinational Digital Circuits): Introduction to combinational circuits, realization of logic expressions using AOI, NOR, and NAND gates. Adders, Subtractors, Multiplexers, De-multiplexers, Encoders, Decoders, Priority encoders, Arithmetic circuits, such as multipliers, Ripple adders, Code-convertors

Unit 3 (Sequential Digital Circuits): Introduction to sequential circuits, Moore and Mealy machine, Flip-flops and Latches, realization of flip-flops using S-R flip-flop, master slave flip-flop,

JK flip-flop, T and D flip-flops, Realization of flip-flops using logic gates, introduction to shift registers, realization of different types of shift registers, introduction to counters, realization ofdifferent types of counters

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	1											3	2	
CO-2	3	1											3	2	
CO-3	3	3	3	3	2								3	3	
CO-4	3	3	3	3	2								3	3	
CO-5	3	3	3	3	1								3	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	04	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Mano, M.M. and Ciletti, M.D., 2007, Digital Design, 4th Ed., Prentice-Hall.

b. Recommended Reading

1. Jain, R.P., 2010, Modern Digital Electronics, 3rd Ed., Tata McGraw-Hill.
2. Floyd, T.L., 2007, Digital Fundamentals, 8th Ed., Pearson Education.
3. Ananda Kumar, A., 2009, Switching Theory and Logic Design, Prentice Hall ofIndia.

c. **Magazines and Journals**
   1. IEEE transaction on Very Large-Scale Integration (VLSI) Systems
   2. International Journal of VLSI Design

d. **Websites**
   1. https://www.coursera.org/
   2. http://nptel.ac.in/

e. **Other Electronic Resources**

1. https://ocw.mit.edu/

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Course Specifications: Electrical Machines - 1

Course Title	Electrical Machines - 1
Course Code	EEC205A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to understand basic concepts of magnetic circuits and energy conversion system. Students are taught construction, principle of operation, working, characteristics of DC machines and transformers. They are facilitated to understand starting methods, speed control of DC motors, parallel operation and performance analysis of DC generator, testing of DC machines and transformers. The students will be able to recommend suitable DC machines and transformers for any given application.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain working principle, construction, operation of DC machines and transformers usingappropriate governing laws
CO-2. Describe testing and characteristics of DC machines and transformers
CO-3. Discuss starters, speed control techniques of DC motors and parallel operation of generators
CO-4. Derive equations to determine performance parameters of DC machines and Transformers
CO-5. Solve simple and complex problems on DC machines and transformers
CO-6. Recommend suitable DC machines and transformers with specifications and selection criteria for agiven application

4. Course Contents

Unit 1 (Electromechanical Energy Conversion): Faraday's law and Lenz's law, time varying and rotational induced emf,energy balance, force, torque, singly and doubly excited systems.
DC Machines:
Construction of a DC machine, windings: armature windings – lap and wave windings, field windings, commutation, MMF pattern of commutator winding and field winding, magnetic fields in rotating machinery, losses in machines.

Unit 2 (DC Generators:): Principle of operation, emf equation, armature reaction, commutation, remedies for field distortion, compensating windings, methods for improving commutation, equalizer connections, and

problems.

Unit 3 (Performance Characteristics of DC Generators): Shunt, series, compound generators and separately excited

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generator, characteristics, applications. Build-up of emf, critical field resistance, critical speed, failure of self-excitation and remedial measures, losses, efficiency and problems. Parallel Operation of DC Generators: Reasons, requirements, parallel operation of shunt generator, use of equalizer bar, problems.

Unit 4 (DC Motors): Classification, Operating principle, back emf, power stages, starting methods, armature reaction, commutation, characteristics, comparison of characteristics, applications, polarity reversal of DC motor. Methods of speed control: Field control, armature control, speed regulation, problems.

Unit 5 (Testing of DC Machines): Classification of Instruments, Essential features of Indicating Instrument, Deflecting, Controlling and Damping Mechanism, Moving Coil instrument, Moving Iron Instrument Induction type Instruments examples, Wiring materials and accessories, Types of wiring principles of earthing.

Unit 6 (Transformer): Single-phase transformers: construction and principle of operation, equivalent circuit and phasor diagram of ideal transformer and practical transformer for UPF, leading and lagging loads. Voltage regulation, losses, efficiency, parallel operation, problems. Testing of Transformers: OC and SC tests, polarity test, Sumpner's test, separation of losses, problems.

Unit 7 (Three Phase Transformer):
Construction, phasor diagrams, types of connection. Autotransformers: Construction, principle, applications, comparison with two winding transformer. Scott connection,tap-changing transformers, cooling of transformers, problems.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3					3	2						3	3	0
CO-2	3	3	3				2						3	2	0
CO-3	3	2	2	2									3	2	0
CO-4	3	3	3	2									3	2	0
CO-5	3	3	3	3									3	3	1
CO-6	3	3	3	3		3	2						3	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		35

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1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. McPherson, George; Laramore, Robert D, 2014, An Introduction to Electrical Machines andTransformers, 7th Edition, Wiley Publications
3. Kothari D P, Nagrath I J, 2013, Electric Machines, 4th Edition, Tata McGraw Hill
4. P S Bimbhra, 2011, Electric Machines, 7th Edition, Khanna Publishers

b. Recommended Reading

1. Herman, Stephen L, 2012, Electrical Transformers and Rotating Machines, 3rd Edition,Cengage Learning
2. Chakrabarti Abhijit, Debnath Sudipta, 2015, Electrical Machines, McGraw Hill
3. Rajput R K, 2012, 4th Edition, Direct Current Machines, University Science Press

c. Magazines and Journals

1. EDRIVE Magazine

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm

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Course Specifications: Digital Logic Design Laboratory

Course Title	Digital Logic Design Laboratory
Course Code	EEL206A
Course Type	Laboratory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to create a strong foundation of Digital Electronics. The students are taught the basic components of digital systems and the process of their implementation. The students are also taught Boolean algebra, logic gates, basics of memories, and implementationof combinational and sequential digital circuits using logic gates. This course also emphasizes on different types of memories and logic designing platforms and their merits and demerits. Students are trained to employ the principles of digital electronics to implement digital design for the given problem.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Simulate digital logic circuits using standard software
CO-2. Plan an experimental setup to test and verify the truth tables of logic gates
CO-3. Construct digital circuits such as latches, multiplexers and counters to verify theirfunctionalities
CO-4. Design and construct various code converters
CO-5. Write a laboratory report in a prescribed format

4. Course Contents

1	Verification of De Morgan's Theorem, sum-of product and product-of-sum expressions using basic and universal gates
2	Design and implementation of Full Adder and Full Subtractor using basic and NAND gates
3	Design, construction and verification of a BCD to Excess-3 and Excess-3 to BCD code converters
4	Design, construction and verification of a Binary to Gray and Gray to Binary code converters
5	Design and implementation of Multiplexer and De-multiplexer circuits using ICs and verification of their functions
6	Design and implementation of an encoder and decoder circuit using ICs
7	Design and construction of magnitude comparator using appropriate IC

8	Construction and verification of the functions of S-R latch, S-R, J-K, T and D Flip-Flops using NAND and NOR gates

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	1		3							2	3	3	2
CO-2	2	2							3			2	2	3	2
CO-3	3	1	1						2			2	3	2	2
CO-4	3	2	1						1			2	3	1	2
CO-5	1									1		1	1		1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

5. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		40

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
Maximum Marks ▶	25	25	50
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Laboratory Demonstration
2.	Understanding	Laboratory Demonstration, Performing
3.	Critical Skills	Experiments
4.	Analytical Skills	Performing Experiments
5.	Problem Solving Skills	Performing Experiments
6.	Practical Skills	Performing Experiments
7.	Group Work	Performing Experiments
8.	Self-Learning	--
9.	Written Communication Skills	Self-Study
10.	Verbal Communication Skills	Lab Report
11.	Presentation Skills	Viva-Voce
12.	Behavioral Skills	--
13.	Information Management	Performing Experiments
14.	Personal Management	Laboratory Report
15.	Leadership Skills	Laboratory Report

8. Course Resources

a. Essential Reading

1. Course notes
2. Mano, M.M. and Ciletti, M.D., 2007, Digital Design, 4th Ed., Prentice-Hall.

b. Recommended Reading

3. Floyd, Floyd Thomas, L (2007) Digital fundamentals, Eighth edition, PearsonEducation Pvt. Ltd

c. **Magazines and Journals**

4. IEEE Transactions on Circuits and Systems
5. IEEE proceedings on computers and digital techniques.

d. **Websites**

1. http://electronics-course.com/

e. **Other Electronic Resources**

1. https://ocw.mit.edu/index.htm

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Course Specifications: Electrical Machines Laboratory-1

Course Title	Electrical Machines Laboratory- 1
Course Code	EEL207A
Course Type	Laboratory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This laboratory deals with augmenting theoretical concepts of DC machines and transformers with appropriate experiments. Students will be trained to analyze performance characteristics, behavior of DC machines and transformers. Also, perform testing of electrical machines.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

- **CO-1.** Determine performance characteristics of a DC Machine as per the standard procedures
- **CO-2.** Conduct suitable tests on Transformer as per the standard procedures
- **CO-3.** Draw the desired performance characteristics of DC Machines and Transformers
- **CO-4.** Write laboratory report as per the prescribed format

4. Course Contents

Experiment Number	Course Content
1	Determination of critical field resistance from open circuit characteristics of separately excited DC generator.
2	Analysis of external characteristics of separately excited DC generator.
3	Determination of performance characteristics of DC shunt motor by load test.
4	Determination of performance characteristics of DC series motor by load test.
5	Determination of performance characteristics of DC compound motor by load test.
6	Determination of performance characteristics of DC shunt motor by Swinburne's test.
7	Determination of performance characteristics of DC compound generator by load test.
8	Analysis of regeneration in DC machines by Hopkinson's test.
9	Separation of no load losses in a single phase transformer.
10	Parallel operation of two single phase transformer.
11	Determination of efficiency of transformer by Sumpner's test.
12	Phase displacement analysis for various connections of multi-phase transformers.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3					3	2						3	3	0
CO-2	3	3	3				2						3	2	0
CO-3	3	2	2	2									3	2	0
CO-4	3	3	3	2									3	2	0
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

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The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) orsubcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
Maximum Marks ▶	25	25	50
CO-1			
CO-2			
CO-3			
CO-4			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Laboratory Manual
2. McPherson, George; Laramore, Robert D, 2014, An Introduction to Electrical Machines andTransformers, 7th Edition, Wiley Publications
3. Nagrath, I.J. and Kothari.D.P, 'Electric Machines', 4th Edition, T.M.H. Publishing Co.Ltd.,New Delhi

b. Recommended Reading

1. Dr. D K Chaturvedi, 2010, Electrical Machines Lab Manual with MATLAB Programs, LaxmiPublications Pvt. Ltd.
2. Herman, Stephen L, 2012, Electrical Transformers and Rotating Machines, 3rd Edition,Cengage Learning
3. Chakrabarti Abhijit, Debnath Sudipta, 2015, Electrical Machines, McGraw Hill
4. Rajput R K, 2012, 4th Edition, Direct Current Machines, University Science Press

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm

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Course Specifications: Environmental Studies

Course Title	Environmental Studies
Course Code	BTN101A
Course Type	Ability Enhancement Compulsory Course
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with essential aspects of environment and ecosystem with relevance to engineering and technology. The course exposes the students to various problems associated with abuse of natural resources. The concepts of ecosystems, biodiversity and its conservation and environmental pollution will be discussed. The course emphasizes social issues associated with the environment, and the impact of human population on the environment.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Define the multidisciplinary nature of environmental studies and recognize the need for public awareness
CO-2. Classify and explain the various natural resources and their associated problems, ecosystem and environmental pollution
CO-3. Describe biodiversity at local, national and global levels
CO-4. Discuss various social issues pertaining to environment including sustainable development and energy issues
CO-5. Assess the impact of human population on the environment

4. Course Contents

Unit 1 (Introduction and natural resources): The multidisciplinary nature of environmental studies, Definition, scope and importance, Need for public awareness. Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer- pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-

renewable energy sources, use of alternate energy sources, case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit 2 (Ecosystems): Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries).

Unit 3 (Biodiversity and its conservation): Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values. Biodiversity at global, national and local levels, India as a mega- diversity nation, Hot-spots of biodiversity, and Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 4 (Environmental Pollution and Disaster Management): Definition, Causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution, Solid waste management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

Unit 5 (Social Issues, Human Population and Environmental Ethics): Social Issues and the Environment: From unsustainable to sustainable development, Urban problems and related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies, Wasteland reclamation, Consumerism and waste products, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness. Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programmes, Environment and human health, Human Rights, Value Education, Role of Information Technology in Environment and Human Health, Case Studies.

Field Work: Visit to a local area to document environmental assets river/ forest/ grassland/ hill/mountain, Visit to a local polluted site – Urban / Rural / Industrial / Agricultural, Study of common plants, insects, birds, Study of simple ecosystems-pond, river, hill slopes, etc (Field work equal to 5 lecture hours).

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5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1					3							1	3	
CO-2	1					3							1	3	
CO-3	1					3							1	3	
CO-4	1					3		1					1	3	1
CO-5	1					3							1	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate															

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Contribution

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		22
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	00
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		03
1. Case Study Presentation	03	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. **Course Assessment and Reassessment**

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in theProgramme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CEor SEE) or subcomponent of CE (SC1 or SC2), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			

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The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Bharucha, E., 2004, Environmental Studies, New Delhi, University GrantsCommission

b. Recommended Reading

1. Jadhav, H. and Bhosale, V. M., 1995, Environmental Protection and Laws, New Delhi, Himalaya Publishing House

c. Magazines and Journals

1. The Green Guide, Natural Geographic Society
2. Sanctuary Asia
3. Xover
4. Indian Journal of Environmental Protection

d. Websites

1. http://www.indiaenvironmentportal.org.in/
2. http://envfor.nic.in/
3. https://earthdirectory.net/India

e. Other Electronic Resources

1. Electronic resources on the course area are available on RUAS library

Course Specifications: Additional Mathematics - 1

Course Title	Additional Mathematics - 1
Course Code	MTB103A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces students to the basic concepts in real analysis, MATLAB programing andmatrix algebra. Students are taught the concepts of limits, continuity, differentiation, series expansion for the functions of one and two variable, indefinite and definite integrals of single real variable functions. Basic concepts of vectors with necessary properties and operations are taught. The mathematical operations in Matrix theory, Eigen value and Eigen vector, Inversion and diagonalization of matrix and matrix solution for linear system of equations and implementation of the same using MATLAB are discussed in this course.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. State and explain the important theorems and solve simple mathematical problems in one variable calculus and vector algebra
CO-2. State theorems and solve simple problems in two variable calculus
CO-3. Solve complex real world problems associated with one and two real analysis
CO-4. Illustrate fundamentals of MATLAB programming and write simple programs
CO-5. Solve complex mathematical problems associated with linear algebra and comparethe results with that of solutions obtained using MATLAB

4. Course Contents

Unit 1 (Single Variable Calculus): Functions of single real variable, limit, continuity and differentiation. Mean value theorems and their applications. Taylor's Theorem, Taylor and Maclaurin series. Indefinite integrals, methods of integration - integration by parts, integration by substitution, integration by method of partial fractions. Definite integral and its properties, the fundamental theorem of Calculus, areas between curves.

Unit 2 (Two Variable Calculus): Functions of two variables, limits, continuity and partial differentiation. Total differential, errors and approximations, tangent plane approximation of asurface. Partial differentiation of composite functions, unconstrained and constrained extrema

Unit 3 (Vector Algebra): Vectors, properties, vector components, magnitude and argument, dot and cross products.

Unit 4 (MATLAB fundamentals): Introduction to MATLAB, Basic algebraic and matrix operations, built-in and command line functions. Graphics using MATLAB, 2D and 3D plots. Scripts and functions. Relational and logical operators, conditional statements and looping structures, simple programs.

Unit 5 (Linear Algebra): Matrix algebra, elementary row operations, row and reduced row echelon forms. Linear system of equations, existence and uniqueness of solution. Vector spaces, subspaces, linear independence, basis and dimension. Row, column and null spaceof a matrix. Linear transformations.Eigenvalues, eigenvectors and diagonalization

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2							1			3		1
CO-2	3	3	2							1			3		1
CO-3	3	3	2	1						1			3	1	1
CO-4	3	3	2	3						2			3	3	2
CO-5	3	3	2	3						2			3	3	2
			3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		15
1. Course Laboratory	00	
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	

4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in theProgramme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment

14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. James Stewart, 2015, Calculus: Early Transcendentals, 8th edition,Boston, Cengage Learning
2. Steven Leon, 2014, Linear Algebra with Application, 9th edition, New Jersey, Pears
3. Rudra Pratap, 2013, Getting Started with MATLAB: A Quick Introduction forScientistsand Engineers, New York, Oxford University Press

b. Recommended Reading

1. Maurice D. Weir and Joel Hass, 2017, Thomas Calculus, 13th edition, New Jersey,Pearson
2. Gilbert Strang, 2016, Introduction to Linear Algebra, 5th edition, Massachusetts, Cambridge Press

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm
2. https://www.khanacademy.org/
3. tutorial.math.lamar.edu/

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Dean – Academic Affairs
Ramaiah University of Applied Sciences
Bangalore

Course Specifications: Engineering Mathematics - 4

Course Title	Engineering Mathematics - 4
Course Code	MTF202A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces the basic concepts of complex analysis and partial differential equations. The course encompasses the essentials of statistics, probability theory and numerical solution of differential equations. Students are taught the probability theory and statistical distributions needed to quantify uncertainty and accuracy of information. The significance and use of numerical methods for solution of ordinary and partial differential equations are emphasized in this course. The utility of complex analysis to solve complex engineering problems and that of partial differential equations in modeling real world problems are highlighted. The students will be able to implement probabilistic /numerical technique to solve a diverse range of applied mathematical problems using MATLAB.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Define and explain the concepts of correlation, regression, random variables, probability distribution, partial differential equations and complex analysis
CO-2. State theorems and solve simple problems in partial differential equations, complex analysis, probability, probability distributions
CO-3. Apply numerical methods to solve ordinary and partial differential equations using MATLAB
CO-4. Solve complex engineering problems associated with numerical methods using MATLAB
CO-5. Analyze real world problems associated with probability, probability distributions, partial differential equations and complex analysis
CO-6. Construct the Bar chart, pie chart, Histogram, Box-plot and fitting of curves byusing MATLAB

4. Course Contents

Unit 1 (Partial differential equations): Basic concepts, classification of first order partial differential equations. Solutions by Lagrange's method. Classification of second order linear partial differential equations. Solutions of heat, wave and Laplace's equations by method of separation of variables.

Unit 2 (Probability and Probability distribution): Review of basics of probability, conditional probability and Bayes' theorem. Random variables, probability distributions. Probability density function and cumulative density function. Mean and variance of distributions. Binomial, exponential and normal distributions.

Unit 3 (Complex analysis): Complex valued functions, limits, continuity and differentiability. Analytic functions and Cauchy-Riemann equations. Construction of analytic functions, Harmonicfunctions. Complex line integral, Cauchy's integral theorem and integral formula. Taylor and Laurent series. Singularities and residues, Cauchy's residue theorem.

Unit 4 (Correlation and Regression): Review of statistics. Contingency, correlation and regressionCurve fitting: Least squares method - polynomial, exponential and power fit.

Unit 5 (Numerical Methods): Types of errors, numerical solution of ordinary differential equations by single- step methods – Euler's, modified Euler's and Runge-Kutta methods. Multi- step methods – Milne's and Adams' methods. Solution by MATLAB built-in function ode45.

Unit 6 (Finite Difference Method): Finite differences, explicit methods for one dimensional heat and wave equations, stability conditions. Implicit method for one dimensional heat equation. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3											3		
CO-2	2	2	2										2		
CO-3	3	3	2							1			3		1
CO-4	3	3	2		2				1	1			3	2	1
CO-5	3	3	2		2					1			3	2	1
CO-6	3	3			1				1	1			3	1	1

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	15	

3. Engineering Workshop / Course/Workshop / Kitchen	00	15
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study

3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Dennis Zill and Patrick Shanahan, 2013, Complex Analysis, 3rd edition, Jonesand Bartlett
2. Richard Burden and Douglas Faires, 2017, Numerical Analysis, 9th edition,Massachusetts, Brooks/Cole
3. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons Inc

b. Recommended Reading

1. Rao V. Dukkipati, 2011, Applied Numerical Methods using MATLAB, 1stedition, New Delhi, New Age
2. M. K. Jain, S.R.K. Iyengar and R.K. Jain, 2008, Numerical Methods, NewDelhi, New Age
3. James Brown and Ruel Churchill, 2017, Complex Variables and Applications,8th edition, McGraw Hill Education
4. Sheldon Ross, 2013, A first course in probability, 9th edition, Pearsoneducation
5. Richard A. Johnson, 2011, Miller and Freund's – Probability and Statistics forEngineers, 8th edition, Prentice hall India

c. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

d. Other Electronic Resources

1. https://www.khanacademy.org/
2. tutorial.math.lamar.edu/

Dean – Academic Affairs
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Course Specifications: Linear Integrated Circuits

Course Title	Linear Integrated Circuits
Course Code	EEC211A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with linear integrated circuits fabrication and applications in electronic circuits. The students are taught fundamentals, characteristics, and application of Linear ICs. The students are taught to solve numerical problems on fundamentals and applications.Students are trained to design, model, simulate and analyze active filters and multi-vibrators. Application of linear ICs in building ADCs, DACs, PLLs and filters is emphasized.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain Integrated Circuit fabrication processes, op-amp fundamentals and characteristics
CO-2. Discuss the various linear and non-linear applications of op-amps
CO-3. Design, compute and analyse op-amp based circuits
CO-4. Analyse the functionalities of linear and nonlinear ICs for various applications
CO-5. Design, model and analyse active filters, waveform generators, A/D and D/A converters

4. Course Contents

Unit 1 (Introduction to Integrated Circuits): Classification of ICs, IC chip size and circuit complexity, fabrication processes of ICs, fabrication of a typical circuit, active and passive components of ICs: Transistors, diodes, resistors, capacitors, inductors; Fabrication of Field Effect Transistors, Recent trends in IC technology, Advantages of ICs over discrete components

Unit 2 (Operational Amplifier Fundamentals and Characteristics): Basic information of op-amp, ideal op-amp, open loop operation of op-amp, feedback, inverting amplifier, non-inverting amplifier,voltage follower, differential amplifier, differential and common mode gains, CMRR, op-amp internal circuit, transfer characteristics, low frequency small signal analysis of differential amplifier, current mirror, input resistance, active load, level shifters, output stage, 741 op-amp; DC Characteristics: input bias current, input offset current, input offset voltage, output offset voltage and thermal drift; AC characteristics: frequency response, stability, slew rate; analysis of data sheetsof an op-amp

Unit 3 (Operational Amplifier Applications): Scale changer/inverter, summing amplifier – inverting and non- inverting, subtractor, instrumentation amplifier, inverter AC amplifier, non-inverting AC amplifier, AC voltage follower, transconductance amplifier, transresistance amplifier, op-amp circuits using diodes: half wave rectifier, full wave rectifier, precision rectifiers, peak detector, clipper, clamper; log and antilog amplifier, integrator, differentiator, comparator, zero crossing detector, window detector, Schmitt trigger, astable multivibrator, monostable multivibrator, 555 timer: functional diagram, astable and monostable operation, Schmitt trigger; Sine wave generator, triangular wave generator, function generator IC 8038, audio power amplifier, series op-amp regulator, IC voltage regulators, 723 general purpose regulator. Simulation using standard circuit simulation tools

Unit 4 (Active filters and Phase Locked Loops (PLLs)): First, second and higher order low pass filter, high pass filter, band pass filter, band reject filter, all pass filter;, state variable filters, switched capacitor filters; PLL: basic principles, phase detector, voltage controlled oscillator, low pass filter

Unit 5 (D/A and A/D Converters): Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R ladder, flash ADC, counter type ADC, servo tracking ADC, successive approximation converter, dual- slope ADC, DAC/ADC specifications: resolution, linearity, accuracy, monotonocity, settling time, stability

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3	3	2	1									3	2	
CO-4	3	3	2	1									3	2	
CO-5	3	3	2	1									3	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	03	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	02	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom Lectures
2.	Understanding	Classroom Lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment and Exam
6.	Practical Skills	Assignment
7.	Group Work	Assignment
8.	Self-Learning	Self-learning

9.	Written Communication Skills	Assignment
10.	Verbal Communication Skills	--
11.	Presentation Skills	Assignment
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course Notes

2. Choudhary D.R, and Jain S. (2010) Linear Integrated Circuits. New AgeInternational
3. Gayakwad, R.A., (1993) Op Amps and Linear Integrated Circuits. 4th Edition. PHIPublication

b. Recommended Reading

1. Coughlin, Driscoll (2001) Operational Amplifiers and Linear Integrated Circuits.4th Edition, PHI Publication
2. Salivahanan (2008) Linear Integrated Circuits. 1st Edition. McGraw Hill
3. Botkar, K.R. (1993) Integrated Circuits. 9th Edition. Khanna Publication
4. Wiiliam D. Stanley, (2009) Operational Amplifiers with Linear IntegratedCircuits. 4th edition, Pearson Education

c. Magazines and Journals

1. IEEE transaction on circuits and systems

d. Websites

1. http://www.tridenttechlabs.com
2. http://www.advancedchipdesigns.com

e. Other Electronic Resources

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6- 012-microelectronic-devices-and-circuits-spring-2009/
2. Multisim and P-spice

Dean – Academic Affairs
Ramaiah University of Applied Sciences
Bangalore

Course Specifications: Electromagnetic Theory

Course Title	Electromagnetic Theory
Course Code	EEC212A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. **Course Summary**

The aim of the course is to understand the principles of electrostatics, electromagnetics and their applications. The course emphasizes on analysis of electromagnetic waves and fields. Students are taught vectors, electrostatics and magnetostatics. Students are trained to use standard tools to analyze specific parameters of electrostatics, magnetostatics and time varying magnetic fields.

2. **Course Size and Credits:**

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. **Course Outcomes (COs)**

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

CO-1. Explain the concept of vector, co-ordinate system, electrostatics and magnetostatics CO-2. Derive gauss divergence theorem, Stokes' theorem and continuity equation
CO-3. Solve simple and complex problems on capacitance, potential field, electric field and electric force
CO-4. Analyze the concepts of divergence and curl, Faraday's laws of magnetic induction
CO-5. Use standard software tools to solve and analyze specific parameters of electrostatics, magnetostatics

4. **Course Contents**

Unit 1 (Co-ordinate System:): Review of vector analysis, scalar and vector product, gradient, divergence, curl and their physical interpretation, line integral, surface integral, volume integral, stokes theorem, rectangular, cylindrical and spherical co-ordinate system and their transformations.

Unit 2 (Electrostatics – I): Coulomb's Law electrostatic force, electric field intensity, electric potential, electric potential difference, electric dipole and equipotential surfaces, electric flux density, displacement flux, electric field intensity and electrostatic potential due to point charges, line charge, surface charge andvolume charge distribution.

Unit 3 (Electrostatics – II): Gauss's law and its applications; divergence and Gauss divergence theorem, ohm's law, continuity equations and relaxation time; capacitance, equations of capacitance for coaxial cable and two-wire transmission line, energy and energy density in electrostatic fields; boundary conditions: dielectric-dielectric, dielectric-conductor. Poisson's and Laplace's equations: solution to Laplace's equationsfor problems of one dimension.

Unit 4 (Magnetostatics):
Biot–Savart Law and its Applications: Magnetic field intensity(H), magnetic flux density (B), Biot–savart Law, magnetic field due to straight conductors and circular loop, B in free space, Maxwell's second Equation. **Ampere's Circuital Law and its Applications:** Ampere's circuital law, magnetic field due to an infinite sheet of current and a long current carrying filament, Point form of Ampere's circuital law, Maxwell's third equation.

Unit 5 (Magnetic Forces, Potential and Inductance)
Magnetic forces: Lorentz Law of force, force on a moving charge, Force on a differential current element, torque on a conductor; energy and energy density in a magnetic field.
Magnetic Potential and Inductance: Scalar Magnetic potential and its limitations, vector magnetic potential and its properties, vector Poisson's equations. Self and Mutual inductance, Neuman's formulae, Faraday's laws of electromagnetic induction.

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5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	1											2	1	
CO-2	3	3	2	2									3	2	
CO-3	3	3	3	2	1								3	3	
CO-4	3	3	3	3	1								3	3	
CO-5	3	3	3	3	3								3	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		

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1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination

10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. **Course Resources**

a. **Essential Reading**

1. Class Notes
2. Jr. Hayt and Bucker, 2006, Engineering Electromagnetics, 7th Edition, McGraw Hill

b. **Recommended Reading**

1. Jordan & Balman, 2006, Electromagnetic Waves and Radiating System, 4thEdition PHI
2. Johan D. Kraus, 2005, Electromagnetics, 4th Edition, McGraw Hill
3. David K. Cheng, 2009, Fields and Waves Electromagnetics, 2nd Edition,Addison Wesley
4. B.Guru & H. Hiziroglu, 2004, Electromagnetic Field Theory Fundamentals,2nd Edition, Cambridge University Press
5. K. E. Longren, S. V. Savov and R. J. Jost, 2009, Fundamentals ofElectromagnetics with MATLAB, PHI
6. Martin A. Plonus, 1978, Applied Electromagnetics, 2nd Edition McGraw Hill

c. **Magazines and Journals**

1. IEEE Transactions on Microwave Theory and Techniques

d. **Websites**

1. www. web.mit.edu/jbelcher/www/anim.html

e. **Other Electronic Resources**

1. PC Hardware
2. MATLAB software tool

Dean – Academic Affairs
Ramaiah University of Applied Sciences
Bangalore

Course Specifications: Microprocessors and Microcontrollers

Course Title	Microprocessors and Microcontrollers
Course Code	EEC213A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the architecture and applications of microprocessors and controllers. This course facilitates the students to understand the concepts of architecture and operation of embedded processors and controllers. Students are taught to program microprocessors andcontrollers to realize the given functionality. Students are trained to solve practical problems involving interfacing of microprocessors and controllers with the external peripherals.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain architectures of microprocessors, microcontrollers and their applications inembedded systems
CO-2. Describe concepts of peripheral interfacing and programming of microprocessors and microcontrollers
CO-3. Program and verify functionality of given application using microprocessor or microcontroller
CO-4. Perform external peripheral interfacing using microprocessor or microcontroller for agiven application
CO-5. Design applications using microprocessors, microcontrollers and embedded board withexternal peripherals

4. Course Contents

Unit 1 (Introduction to Microprocessor): Overview on evolution of Microprocessors (from 4004to i7), Intel 8085 and 8086 Architecture, Bus Interface Unit and Execution Unit, The InstructionPipeline, Data and Address Bus Configuration, Memory Segmentation, Memory Address generation, I/O Port addressing. Functions of all signals, Minimum and Maximum Mode signals,Bus Cycles, Bus driver 8288

Unit 2 (Programming the Microprocessor): Addressing Modes, Instruction Set in detail, Assembler directives, Assembly Language Programming, Macros, DOS function, interrupt processing, Types of interrupts, Internal interrupts

Unit 3 (Peripherals interfacing and applications using 8086): Memory interfacing, Programmable Peripherals Interface-8255, Programmable I/O Interface 8254, Programmable Interval Timer 8251 Programmable USART, Programmable Interrupt Controller 8259

Unit 4 (Introduction to Microcontroller): Introduction to Microcontroller, Difference between Microprocessors and Microcontrollers, Difference between CISC and RISC Microcontrollers, Advantages and applications of Microcontrollers, Evolution of 8051 family, Architectural features of 8051, Programming model, pin details, I/O Ports, Addressing modes

Unit 5 (Programming the Microcontroller): Instructions set of 8051, Counters and Timers programming, RS 232 standard, Serial I/O in 8051, Interrupts in 8051, Interrupt based Timer/Counter and Serial programming

Unit 6 (Peripherals interfacing and applications using 8051): External memory interface, LCD, ADC, DAC, Sensor, seven-segment display, DC motor, Stepper Motor, Keyboard, Interfacing using 8255

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3	2	2	2	3								2	3	
CO-4	3	2	2	2	3								2	3	
CO-5	3	2	2	2	3								2	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: ModerateContribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	05	

2. Guest Lecture	00	05
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--

13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Brey, Barry B. (2008), 'The Intel Microprocessors', Prentice Hall Press.
3. Mazidi, Muhammad Ali, Janice Gillispie Mazidi, and Rolin McKinlay D. (2006),' The 8051 microcontroller and embedded systems: using Assemblyand C', Vol. 626. Pearson/Prentice Hall.

b. Recommended Reading

1. Ray, Ajoy K., and Kishor,M., Bhurchandi(2006) Advanced microprocessorsand peripherals: architecture, programming and interfacing, Tata McGraw Hill Education Private Limited.
2. Liu, Yu-Cheng, and Glenn Gibson, A. (1986) Microcomputer systems: the 8086/8088 family architecture, programming and design
3. Ayala, Kenneth,J. (2004) The 8051 microcontroller, Cengage Learning.Magazines and

c. Journals

1. The IUP Journal of Electrical and Electronics
2. Microcomputer Journal
3. Electronic Engineering Times
4. The Computer Journal

d. Websites

1. www.sci.electronics.com
2. http://www.embeddedrelated.com/usenet/embedded.php

e. Other Electronic Resources

1. https://www.electronicshub.org/difference-between-microprocessor-and-microcontroller/

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Course Specifications: Measurements and Instrumentation

Course Title	Measurements and Instrumentation
Course Code	EEC214A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to introduce the principles of electrical and electronics measurements instrumentation. It deals with measurement system which includes sensors and transducers, signal conditioning circuits, recording, display devices, signal generators and function generators. This course also deals with static, dynamic characteristics of measurement system.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe measurement standards, measurement units and measurement systems
CO-2. Explain the principles and applications of signal and function generators
CO-3. Describe different sensors and their usage in various applications.
CO-4. Analyse the models of measurement systems and analyze their static and dynamic characteristics
CO-5. Design appropriate signal conditioning circuits and choose recording / display devices
CO-6. Design of instrumentation for a system and measure resistance, capacitance, inductance, current, voltage and power

4. Course Contents

Unit 1 (Introduction to Measurements and Instrumentation): Introduction and Basics of Measurements, Instrument types and Performance characteristics, Errors in Measurements, Problems encountered during measurement of living system and solution for the same, Calibrationand Standards

Unit 2 (Sensors and Transducers): Introduction to Sensors and Transducers, Data Acquisition and Sensors Classification, Types of Sensors and Transducer; Mechanical Sensors (Force Sensor, Pressure Sensor, Flow Sensor, Speed and Velocity Sensor, Accelerometer, Gyroscope, Other types of Mechanical Sensors); Temperature Sensors , Optical and Chemical Sensors

Unit 3 (Bridge Measurement): Bridge Circuit: Definition, Advantages, Types and differences between them. Introduction to Resistor, Capacitor and Inductor Basics. D.C Bridges (Wheatstone

Bridge, Kelvin's Bridge and Kelvin's Double Bridge); A.C Bridges (Inductance -- Maxwell's Inductance Bridge, Maxwell's Wein Bridge, Hay Bridge and Anderson's Bridge Capacitance -- De- Sauty Bridge,Schering Bridge and Wien Bridge Shielding and Grounding of Bridges)

Unit 4 (Display Devices): Basics of different kinds of Display Devices, Cathode Ray Tube, Cathode Ray Oscilloscope, LED and LCD, Applications. Electronic and Digital Instruments: Signal conditioning circuits, function generator, Basics of Electronics and Digital Instruments, Electronic Multimeter, Tachometer, Velocimetry, Vibrometry, Flow meter, IR Camera, Weather measurement, Applications.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3	1	2										3		
CO-4	3	2	2										3		
CO-5	3	2	2	1									3		
CO-6	3	2	2	3									3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	

Mid Terms, Laboratory Examination/Written Examination, Presentations	10
Total Duration in Hours	**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the followingTable.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. K. Sawhney, (2008) Electrical and Electronic Measurements andInstrumentation, Dhanpatrai and Sons, New Delhi.
3. Cooper D. and A.D. Heifrick (2009) Modern Electronic Instrumentation andMeasuring Techniques, PHI

b. Recommended Reading

1. Carr. (2003) Elements of Electronic Instrumentation and Measurements, 3rd Edition,Pearson Education
2. Walt. (2003) Instrumentation Reference Book, 3rd Edition, Elsevier Science
3. Bell. (2002) Electronic Instrumentation and Measurements, Prentice Hall of India
4. Bentley. (2000) Principles of Measurement Systems, 3rd Edition, Pearson Education

c. Magazines and Journals

1. IEEE Transactions on Instrumentation and Measurement
2. Journal of Instrumentation (JINST)
3. Journal of Instrumentation Science and Technology
4. Journal of Instrumentation Technology and Innovations
5. Instrument Society of India Journal

d. Websites

1. http://www.ieee-ims.org
2. http://www.ni.com/academic/measurements.htm

e. Other Electronic Resources

1. Trainer Kits

Dean – Academic Affairs
Ramaiah University of Applied Sciences
Bangalore

Course Specifications: Electrical Machines-2

Course Title	Electrical Machines-2
Course Code	EEC215A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to understand basic concepts of AC and special machines. Students are taught construction, principle of operation, working, characteristics and applications of AC and special machines. They are facilitated to understand starting methods, speed control of AC motors, parallel operation and performance analysis of AC generators and testing of AC machines. Students will be able to analyze performance characteristics of AC machines and special purpose machines.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe the construction, principle of operation, working, characteristics and types of AC and special machines
CO-2. Explain phasor diagrams, equivalent circuit, starting methods and speed control techniques forAC machines
CO-3. Derive equations for performance analysis of AC machines
CO-4. Discuss two reaction theory, slip test, parallel operation, regulation of alternators, power flow diagram, crawling and cogging
CO-5. Solve simple and complex problems on AC machines
CO-6. Analyze performance characteristics of AC machines and special purpose machines for various applications

4. Course Contents

Unit 1 (Synchronous Generator): Construction, principle of operation, types, distribution factor, pitch factor, armature reaction, synchronous reactance, phasor diagrams, equivalent circuit, two reaction theory, slip test,
e.m.f and power equations for salient and non-salient synchronous machine, power-angle characteristics, e.m.f, m.m.f, ZPF and ASA methods, synchronization, parallel operation of alternators.

Unit 2 (Synchronous Motor): Principle of operation, starting methods, phasor diagrams, torque and

power equations, operating characteristics with constant load and variable excitation, operating characteristics with variable load and constant excitation, V-curves and inverted V-curves, hunting, synchronous condenser. **Unit 3 (Single Phase Induction Motors):** Double revolving field theory, equivalent circuit and torque expression, torque slip characteristics, working of split phase, capacitor start, capacitor run, capacitor start and run, selection of capacitance for maximum torque, applications.

Unit 4 (Three Phase Induction Motor): Construction, types, principle of operation, slip, rotor resistance, inductance, e.m.f and current, relationship between copper loss and the motor slip, power flow diagram, factors determining the torque, torque-slip curve, effect of rotor resistance, crawling and cogging, double cage motor, necessity of starter, auto transformer starter, star delta starter, DOL starter, causes of low power factor,applications

Unit 5 (Special Purpose Machines): Construction, working principle of universal motor, linear induction motor, stepper motor, switched reluctance motor, hysteresis motor, BLDC motor, applications.

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSO's)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		3									3		
CO-2	3	3		3									3		
CO-3	3	3											3	3	
CO-4	3	1	3	3									3	3	
CO-5	3			3										3	2
CO-6	1				3				3					3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	02	
3. Demonstration on a Computer	01	
Numeracy		25
1. Solving Numerical Problems	25	
Practical Work		03
1. Course Laboratory	03	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		02
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	02	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

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7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class Room Lectures, assignment
2.	Understanding	Class Room Lectures, assignment
3.	Critical Skills	Class Room Lectures, assignment
4.	Analytical Skills	Class Room Lectures, assignment
5.	Problem Solving Skills	Class Room Lectures, assignment
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course Work
13.	Information Management	Assignment, examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Jacek F. Gieras, 2016, Electrical Machines: Fundamentals of Electromechanical EnergyConversion, 1st Edition, CRC Press,
3. Nagrath, I.J. and Kothari, D.P., 2013, Electric Machines, 4th Edition, TMH publishing Co. Ltd.,New Delhi,

b. Recommended Reading

1. Fitzgerald, Charles Kingsley, A.E., Stephen, Jr., Umans, D., 2003, Electric Machinery, 6thEdition, McGraw Hill
2. Mukesh K. Pathak, Mulukutla S. Sarma, 2008, Electric Machines, 1st Edition, CengageLearning
3. Ashfaq Hussain, 2002, Electrical Machines, 2nd Edition, Dhanpat Rai and Co.

c. Magazines and Journals

1. Elsevier International Journal on Industrial Applications of Variable Speed Drives

d. Websites

1. https://www.edx.org/
2. https://www.coursera.org/
3. http://nptel.ac.in/
4. https://ocw.mit.edu/index.html

e. Other Electronic Resources

1. Electronic resources on the course area are available in RUAS library

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Bangalore

Course Specifications: Electrical Circuits and Measurements Laboratory

Course Title	Electrical Circuits and Measurements Laboratory
Course Code	EEL216A
Course Type	Laboratory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This laboratory deals with augmenting theoretical concepts of electrical circuits and measurements. Students are taught to measure the values of passive elements, measurement of power in balanced loads, analyze the behavior of RLC resonant circuits and two port networks. Also, simulate electric circuits using standard tools.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Plan the experimental setup to achieve the stated aim
CO-2. Identify the type and range of the instruments required based on the type of test tobe conducted
CO-3. Conduct experiments as per the standard procedures and tabulate the measured values
CO-4. Model, Simulate and test electric circuits using standard software tool
CO-5. Interpret the results by comparing with the simulation results and draw conclusions
CO-6. Write laboratory report as per the prescribed format

4. Course Contents

Experiment No.	Course Content
1	Measurement of low resistance using Kelvin's double bridge
2	Measurement of inductance using Maxwell Inductance-Capacitance bridge and determination of Q-factor
3	Measurement of capacitance by De-Sauty's bridge
4	Analysis of series and parallel resonance circuits

5	Determination of self and mutual inductances, co efficient of coupling
6	Determination of Z and Y Parameters of two port networks
7	Determination of transmission and hybrid parameters of two port networks
8	Measurement of active and reactive power in star connected balanced loads
9	Measurement of active and reactive power in delta connected balanced loads
10	Simulation of DC circuits using standard software tool
11	Simulation of DC transient response using standard software tool

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3		2					1	1			3	2	1	
CO-2	3	3											3	0	0	
CO-3	3	3											3	0	0	
CO-4	3	3	3		2				1	1			3	2	1	
CO-5	3	3	3		2				1	1				2	1	
CO-6	3	3	3		2				1	1			3	2	1	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution																

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	

Term Tests, Laboratory Examination/Written Examination, Presentations	6
Total Duration in Hours	**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
Maximum Marks ▶	25	25	50
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learningmethods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	Laboratory work
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work

14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Laboratory Manual
2. A. K. Sawhney, 2003, Electrical and Electronic Measurements and Instrumentation,Dhanpatrai and Sons, New Delhi
3. M. E. Van Valkenburg, 2002, Network Analysis, 3rd Edition, Pearson.

b. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

Dean – Academic Affairs
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Course Specifications: Microprocessors and MicrocontrollersLaboratory

Course Title	Microprocessors and Microcontrollers Laboratory
Course Code	EEL217A
Course Type	Laboratory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. **Course Summary**

This laboratory deals with developing applications using microprocessor and microcontroller. The students are taught programming microprocessor, microcontroller and embedded board such as Arduino. Students are trained to solve practical problems involving interfacing of microprocessors and controllers with the external peripherals. In addition, students are trainedto design applications for given practical scenarios.

2. **Course Size and Credits:**

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. **Course Outcomes (COs)**

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

CO-1. Develop the assembly level program on a Microprocessor / Microcontroller for a given application
CO-2. Design circuits for performing given tasks using Arduino board
CO-3. Interface external peripherals with Arduino board for given applications
CO-4. Demonstrate the developed designs for different applications
CO-5. Write the report as per the prescribed format

4. **Course Contents**

1	8086 microprocessor to perform arithmetic operations on 8 bit and 16 bit numbers using EMU 8086 software
2	8086 microprocessor to perform arithmetic operations on 8 bit and 16 bit numbers using kit
3	Code conversion: Binary to Gray & Gray to Binary using 8086 microprocessor
4	Sorting a list of numbers in ascending & descending order using 8086 microprocessor
5	8051 microcontroller to perform arithmetic operations on 8 bit and 16 bit numbers using software
6	8051 microcontroller to perform arithmetic operations on 8 bit and 16 bit numbers using kit
7	Code conversions: Decimal to hexadecimal and vice versa using 8051
8	Create a 10KHz square wave using Timer0
9	Implement LED blinking and fading using Arduino board

10	Interface LCD with Arduino board to display message
11	Interface IR and ultrasonic sensor with Arduino board
12	Design a stepper motor controller and traffic light controller

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	3	3				3				3	3	
CO-2	3	3	2	3	3				3				3	3	
CO-3	3	3	1	3	3				3				3	3	
CO-4	3	3	2	3	3				3				3	3	
CO-5	3									3			3		
3: Very Strong Contribution, 2: Strong Contribution, 1: ModerateContribution															

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. **Course Assessment and Reassessment**

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented

in the programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
Maximum Marks ▶	25	25	50
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, Examination
10.	Verbal Communication Skills	Laboratory Examination
11.	Presentation Skills	
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	Laboratory instruction

9. Course Resources

a. Essential Reading

1. Lab Manual
2. Brey, Barry B (2008), 'The Intel Microprocessors', Prentice Hall Press

3. Mazidi, Muhammad Ali, Janice Gillispie Mazidi, and Rolin McKinlay, D., (2006), The 8051 microcontroller and embedded systems: using Assembly and C, Vol.626. Pearson/Prentice Hall

b. Recommended Reading

1. Ray, Ajoy, K. and Kishor Bhurchandi, M. (2006) Advanced microprocessors and peripherals: architecture, programming and interfacing, Tata McGrawHill Education Private Limited.
2. Liu,Yu-Cheng, and Glenn Gibson,A.,(1986) Microcomputer Systems: The 8086/8088 family architecture, programming and design.
3. Ayala, Kenneth, J. (2004), The 8051 Microcontroller, Cengage Learning.

c. Magazines and Journals

1. The IUP Journal of Electrical and Electronics
2. Microcomputer Journal
3. Electronic Engineering Times
4. The Computer Journal

d. Websites

1. www.sci.electronics.com
2. http://www.embeddedrelated.com/usenet/embedded.php

e. Other Electronic Resources

1. https://www.arduino.cc/en/Tutorial/HomePage

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Course Specifications: Innovation and Entrepreneurship

Course Title	Innovation and Entrepreneurship
Course Code	BAU201A
Course Type	Core Theory Course
Department	Management Studies
Faculty	Management and Commerce

1. Course Summary

This course on Innovation and Entrepreneurship is introduced across all the undergraduate programs with an aim to impart comprehensive knowledge of an entrepreneurial ecosystem. Further, the course enables to develop entrepreneurial skills by building entrepreneurialintentions among students. The students also gain knowledge on competencies to provide with necessary inputs for creation of new ventures and scaling up existing startups. The students are also introduced to design thinking process to nurture entrepreneurial way of thinking.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Respective Department of the Faculty
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain the concepts and process of Innovation as well as entrepreneurship
CO-2. Construct and apply the idea generation techniques
CO-3. Discuss the opportunities for launching of new venture and various entry strategies **CO-4.** Examine innovative ideas for the creation and management of entrepreneurship **CO-5.** Formulate and present a viable business plan to the investor's appraisal

Course Contents

Unit 1: Introduction to Entrepreneurship
Introduction to entrepreneurship, Evolution of the concept, Entrepreneurial process, Types of Entrepreneurship - Social entrepreneurship, rural entrepreneurship. Characteristics of an Entrepreneur, Incorporation of a Company, Managing a Family Business, Corporate Intrapreneurship

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Unit 2:

Innovation and Creativity: Types of Innovations. Identify Various Sources of Ideas for New Ventures, Methods Available for Generating New Venture Ideas - Creativity, Design Thinking and the Techniques for Creative Problem Solving. Aspects of the Product Planning and Development Process.

Unit 3
New Venture:
Creating Opportunities, Resources, Role of New Ventures and Small Businesses in the Economy,Types ofEntry Strategies, Launch a New Venture and the Generic Strategies

Unit 4
Strategies to Sustain and Grow:
Strategies for Expansion, Joint Ventures, Acquisitions, Merges, Franchising, Growth Strategy,Exit Strategy.

Unit 5 Business Plan
Business plan, scope and value of the business plan, step-by-step explanation of the business plan, marketing plan, Organizational plan, financial plan (source of capital), entrepreneurship models

4. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	2	2									2			3
CO-2	3	2	2	2	3								3	2	
CO-3	3	3	2	2								2		2	
CO-4	3	2	2	2	2	3			3	3			2		3
CO-5	2	3		2							3		2	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

5. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Posters	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		03
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	03	

4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		15
1. Case Study Presentation	05	
2. Guest Lecture	01	
3. Industry / Field Visit	02	
4. Brain Storming Sessions	02	
5. Group Discussions	04	
6. Discussing Possible Innovations	01	
Mid Terms, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		**45**

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Program Specifications document pertaining to the UG Program. The procedure to determine the finalcourse marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CEor SEE)or subcomponent of CE (SC1, SC2), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, shall provide the focus of COs in each component of assessment in the beginning of the semester to capture the Group Task evaluation parameters such as: field visit, presentation of business plan, case study presentation on success and failurecompanies. Ideating and running the business for a day inside the campus.

Course reassessment policies are presented in the Academic Regulations document.

7. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures
2.	Understanding	Class room lectures
3.	Critical Skills	Assignment
4.	Analytical Skills	Class room, assignment, examination
5.	Problem Solving Skills	Assignment, Field visit and presentation
6.	Practical Skills	Assignment

7.	Group Work	Case study Presentation
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Case study and group discussions
11.	Presentation Skills	Case study and group discussions
12.	Behavioral Skills	Group discussions
13.	Information Management	Assignment
14.	Personal Management	Assignment and Group Discussion
15.	Leadership Skills	Group discussions and Case study

8. Course Resources

a. Essential Reading

1. Course notes
2. Hisrich, R., Peters, M. and Shepherd, D., 2020. *Entrepreneurship*. 11th ed. Noida:McGraw Hill.

b. Recommended Reading

1. Charantimath, P., 2018. *Entrepreneurship development and small businessenterprises*. 3rd ed. Belgaum, India: Pearson Education.
2. Roy, R., 2020. *Entrepreneurship*. 3rd ed. Noida: Oxford University Press.

c. Magazines and Journals

1. Business World: ABP Group
2. Journal of Small Business Management, Blackwell Publishing
3. Business Strategy: PwC Strategy & Inc.

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Course Specifications: Additional Mathematics - 2

Course Title	Additional Mathematics - 2
Course Code	MTB104A
Course Type	Core Theory
Department	Mathematics and Statistics
Faculty	Engineering and Technology

1. Course Summary

This course deals with analytical solutions of ordinary differential equations, numerical analysis and data modelling techniques. Students are taught the concepts of fundamentals of ordinary differential equations. The solution procedures for certain standard forms of ordinary differential equations are illustrated. The role, relevance of ordinary differential equations in modelling some of the real world problems are emphasized. The significance of data modelling in applied engineering problems are discussed with the help of MATLAB. Numerical methods for the solution of nonlinear equations and linear systems are elucidated using MATLAB.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:1:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe the fundamentals of ordinary differential equations State theorems and solve simple problems in two variable calculus
CO-2. Solve standard forms of ordinary differential equations Illustrate fundamentals of Linear algebra
CO-3. Model real world problems using ordinary differential equations and solve complex problems associated with ordinary differential equations
CO-4. Apply numerical methods to solve nonlinear equations in one variable, system of linear equations, interpolation and numerical quadrature, and implement the same using MATLAB
CO-5. Solve complex problems associated with nonlinear equations and linear systems, interpolation and numerical integration using MATLAB

4. Course Contents

Unit 1 (First Order Differential Equations): Introduction, basic concepts and geometrical meaning. Separable, linear and exact differential equations. Integrating factors and transformations. Applications of first order ordinary differential equations, orthogonal trajectories, growth/decay problems and mixture problems.
Unit 2 (Higher Order Differential Equations): Introduction, initial and boundary value problems. Linear homogenous/nonhomogeneous differential equations with constant coefficients, method of undetermined coefficients and variation of parameters. Application of second order

linear differential equations with constant coefficients, mass-spring-dashpot system, electric circuits.

Unit 3 (System of Linear Differential Equations): Homogeneous system of linear differential equations of first order, solutions by matrix method.

Unit 4 (Single Variable Equations and System of Equations): Numerical solution of algebraic and transcendental equations, Newton-Raphson method and error analysis. Numerical solution of linear system of equations, Gauss-Seidel methods.

Unit 5 (Interpolation and Numerical Integration): Interpolation - Lagrange interpolation, Newton's divided difference interpolation. Numerical Integration - Newton-Cotes' quadrature, trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2										3		
CO-2	2	3	2										3		
CO-3	3	3	1										3		
CO-4	3	3	2	2	2					1			3	2	1
CO-5	3	3	2	2	2					1			3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		15
1. Course Laboratory	00	
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

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The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) orsubcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Shepley Ross, 2007, Introduction to Ordinary Differential Equations, 4th edition, New York,John Wiley & sons
2. Dennis Zill, 2012, A First Course in Differential Equations, 10th edition, Massachusetts,Brooks/Cole
3. Richard Burden and Douglas Faires, 2017, Numerical Analysis, 9th edition, Massachusetts,Brooks/Cole

b. Recommended Reading

1. George Simmons, 2017, Differential Equations with Applications and Historical Notes, 2ndedition, New Jersey, McGraw Hill
2. Steven Chapra and Raymond Canale, 2016, Numerical Methods for Engineers, 7th edition, NewJersey, McGraw Hill

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. https://ocw.mit.edu/index.htm
4. tutorial.math.lamar.edu/

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Course Specifications: Transmission and Distribution

Course Title	Transmission and Distribution
Course Code	EEC301A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to emphasize on principles of transmission and distribution of electrical power. Students are taught basic concepts, classification, characteristics and performance limits of transmission anddistribution systems. They are facilitated to understand design of overhead lines, insulators, corona, Ferrantieffects, transmission line constants, performance of short, medium, long transmission lines and underground cables. They are also trained to model, simulate and analyze the performance characteristics of transmissionlines.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain components of power transmission systems, distribution systems
CO-2. Describe different modes of bulk power transmission, HVAC and HVDC systems, types of insulatorsand UG cables, testing of cables and insulators
CO-3. Derive expressions for sag, corona, line parameters, performance parameters of undergroundcables, string efficiency of insulator
CO-4. Discuss performance parameters of power transmission lines, sag, corona and distribution system
CO-5. Solve simple and complex numerical problems on sag, corona, insulator and line parameters
CO-6. Solve simple and complex numerical problems on performance of transmission lines, undergroundcables, uniform and concentrated loads on distribution system

4. Course Contents

Unit 1 (Transmission and Distribution Systems): Modes of bulk power transmission, general layout of power systems, standard voltages for transmission, sub-transmission systems, high voltage transmission: HVAC and HVDC,comparison, transmission efficiency and line drop, feeders, distributors and service mains, comparison of modes ofbulk power transmission.

Unit 2 (Overhead Transmission Lines): Types of supporting structures and line conductors, sag calculations: supports are at same and different levels, effect of ice and wind loading, stringing chart.

Unit 3 (Corona): Phenomena, expression for disruptive critical voltage, visual critical voltage and corona power loss.

Unit 4 (Insulators): Types, potential distribution over a string of suspension insulators, string efficiency, methods ofincreasing string efficiency, testing of insulators.

Unit 5 (Underground Cables): Types, materials, insulation resistance, charging current, grading of cables: capacitancegrading, inter sheath grading and testing of cables.

Unit 6 (Line parameters): Calculation of inductance of single phase and 3-phase lines, capacitance calculation for single phase and 3-phase line.

Unit 7 (Performance of Power Transmission Lines): Classification of transmission lines: short, medium and long transmission lines, ABCD constants, Ferranti effect and skin effect.

Unit 8 (Distribution Systems): Fundamentals of distribution systems, primary distribution configurations, urban networks, primary voltage levels, distribution substations, radial and ring main systems, types of DC distributors, ACto DC distribution: calculation for concentrated loads and uniform loading.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3											1	3	0	1
CO-2	3	2	2	2		1	1						3	2	0
CO-3	3	2	1	2	1		2					1	3	2	1
CO-4	3	2	1		1								3	1	0
CO-5	3	3		2									3	2	0
CO-6	3	3		2									3	2	0
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	

3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--

13.	Information Management	Assignment
14.	Personal Management	--

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15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. W.D Stevenson, 2014, Elements of Power System Analysis, Emeritus, Mc. Graw - Hill. Comp.Ltd.
3. S. N Singh, 2014, Electric power generation Transmission & Distribution, PHI.

b. Recommended Reading

1. Leonard Grigsby L., 2012 , Electric Power Generation, Transmission, and Distribution, ThirdEdition, CRC Press

c. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

Course Specifications: Digital Signal Processing

Course Title	Digital Signal Processing
Course Code	ECC302A
Course Type	Core Theory Course
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the basic concepts of digital signal processing. It deals with the discrete time signals and principles of discrete Fourier transform techniques. Students are taught Fourier transforms as applied to discrete signals, digital filter design techniques, IIR, FIR structures and the concepts of multirate signal processing. Students are taught to design simple digital systems based on analysis of system response.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electronics and Communication Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe types of signals, transforms, filters, algorithms and its properties.
CO-2. Explain the filter design techniques, types of transformations, and multirate principles in signal processing.
CO-3. Determine Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT),
CO-4. Determine convolution using DFT and filter structures for discrete time sequences
CO-5. Design digital filters using IIR and FIR using structures
CO-6. Apply principles of Fourier transforms for spectral analysis of digital signals and systems.

4. Course Contents

Unit 1 (Discrete Fourier Transform): Review of discrete-time signals & systems, DFS representation of periodic sequences, Discrete Fourier Transforms (DFT): Properties of DFT, linear convolution of sequences using DFT, Computation of DFT. Relation between Z- transform and DFS., Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT and FFT for composite.

Unit 2 (Infinite Impulse Response Filter): Analog filters – Butterworth filters, Chebyshev Type 1 filters (up to3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method-Realization structures for IIR filters – direct, cascade, parallel forms.

Unit 3 (Finite Impulse Response Filter): Design of linear phase FIR filters windowing and Frequency sampling methods – Realization structures for FIR filters – Transversal and Linear phase structures-Comparison of FIR& IIR.

Unit 4 (Multirate Signal Processing): Introduction to Multirate signal processing, Decimation, Interpolation, Polyphase Decomposition of FIR filter, Multistage implementation of sampling rate conversion, Design of narrow band filters and applications of Multirate signal processing.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3	0	0
CO-2	3												3	0	0
CO-3	2	2											2	0	0
CO-4	2	2											2	0	0
CO-5	1	3	2	1									3	1	0
CO-6	1	2	2										2	0	0
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom Lectures, Assignments
2.	Understanding	Classroom Lectures, Assignments
3.	Critical Skills	Classroom Lectures, Assignments
4.	Analytical Skills	Classroom Lectures, Assignments
5.	Problem Solving Skills	Classroom Lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Coursework
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Mitra, S.K. (1998) Digital Signal Processing- A Computer Based approach, Tata McGraw- Hill

3. Oppenheim, A.V., and Schaffer R.W. (2004) Discrete Time Signal Processing, PHI.

b. Recommended Reading

1. John G. Proakis, Dimitris Manolakis, G. (2007) Digital Signal Processing-Principles, Algorithms,and Applications, Pearson Education.
2. Vaidyanathan,P.P. (1993) Multirate Systems and Filter Bank, Prentice Hall, Englewood cliffs:NJ

c. Magazines and Journals

1. IEEE Transactions on Signal Processing

d. Websites

1. https://www.tutorialspoint.com/digital_signal_processing/index.htm

e. Other Electronic Resources

1. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011

Course Specifications: Control Systems

Course Title	Control Systems
Course Code	EEC303A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to understand basic concepts of Linear Time Invariant (LTI) systems. The students are taught mathematical modelling, time, frequency and state space analysis, stability of LTI systems and design of controllers. They are also facilitated to understand modelling, simulation of linear control systems using standard software tools. Students will be able to analyse a given control system both in time and frequency domains.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Demonstrate the understanding of control systems
CO-2. Obtain mathematical models of various physical systems
CO-3. Design controllers and compensators for given specifications
CO-4. Analyze practical problems and develop controllers to solve the problems
CO-5. Apply control system concepts for real world applications

4. Course Contents

Unit 1 (Concepts of Control Systems): Introduction to control systems, Open loop and closed loop systems,Examples, Effects of feedback, Classification, Applications

Unit 2 (Mathematical Model of Physical Systems): Linear differential equations, Order and degree of a system, Overview of Laplace transforms, Transfer functions of various physical systems, Analogous systems,Block diagram and signal flow graph analysis

Unit 3 (Time Response Analysis): Standard input signals: Step, ramp, parabolic and impulse, analysis of firstorder system, second order systems and time domain specifications

Unit 4 (Controller Design): Proportional, Integral, Derivative, Proportional integral, Proportional integral derivative controllers, Transfer function, Applications

Unit 5 (Stability Analysis): Characteristic equation, Necessary and sufficient conditions, Routh – Hurwitzcriteria of stability. Root locus plots.

Unit 6 (Frequency Response Analysis): Introduction to Bode plots, sketching individual Bode components,Bode plots of complex transfer functions, Gain margin, Phase margin, Stability analysis.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		2			2	1	1	1	2	3	3	2	3
CO-2	3	3	3	3	3		2						3	3	0
CO-3	3	3	3	3	3	3		1			2	2	3	3	2
CO-4	3	3	3	3	2	3	3		3	1	1	2	3	3	3
CO-5	3	3	3		2				1	1			3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		04
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		21
1. Solving Numerical Problems	21	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

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The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Gopal M., 2002, Control Systems: Principles and Design, 3rd Ed., Tata McGraw-Hill.

b. Recommended Reading

1. Dorf, Richard, C. and Bishop, R.H., 2008, Modern Control Systems, 3rd Ed., Pearson Education.

2. Katsuhiko, 2010, Modern Control Engineering, 4th Ed., Prentice Hall

c. Magazines and Journals

1. IEEE transaction on control systems technology
2. IEEE transaction on automatic control

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

Electronic resources on the course area are available on RUAS library

Course Specifications: Electrical Machine Design

Course Title	Electrical Machine Design
Course Code	EEC304A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to deal with the electrical machine design considerations and facilitates the studentsto understand choice of electric loadings, magnetic loadings and thermal design aspects. They are taught design of transformer and rotating electrical machinery. Students will be able to do dimensional analysis and performance prediction of electrical machines for designed values.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain design parameters, specific electric and magnetic loading of static and rotatingelectrical machines
CO-2. Discuss mmf calculation, thermal rating of static and rotating electrical machines
CO-3. Design armature and field system for DC machines
CO-4. Design core, yoke, windings and cooling systems for transformers
CO-5. Design stator, rotor for asynchronous and synchronous machines
CO-6. Analyze the performance prediction for designed values of static and rotating electricalmachines for a given application

4. Course Contents

Unit 1 (Electrical Machine Design): Electrical engineering materials, choice of specific electrical and magnetic loadings, thermal design: heat flow, temperature rise. Rating of machines, standard specifications.

Unit 2 (DC Machines): Output equation, main dimensions, magnetic circuit calculations, Carter's coefficient,net length of iron, real and apparent flux densities, selection of number of poles, design of armature, designof commutator and brushes, performance prediction using design values.
Unit 3 (Transformers): Output equations, main dimensions, kVA output for single and three phase transformers, window space factor, overall dimensions, temperature rise in transformers, methods of cooling, design of tank.

Unit 4 (Induction Motors): Output equation, main dimensions, length of air gap, rules for selecting rotor slotsof squirrel cage, design of rotor bars, slots, end rings and wound rotor.

Unit 5 (Synchronous Machines): Output equation, choice of loading, short circuit ratio, design of salient polemachines, shape of pole face, armature design, estimation of air gap length, design of rotor, damper windingand field winding; determination of full load field mmf, design of turbo alternators and rotor.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSO's)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3							2					3		
CO-2	3				2		2					2	3		
CO-3			3									2	3	2	
CO-4			3									2	3	2	
CO-5			3									2	3	2	
CO-6	3		2	3		1	2					2		3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		25
1. Solving Numerical Problems	25	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme

Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) orsubcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, assignments
2.	Understanding	Class room lectures, assignments
3.	Critical Skills	Class room lectures, assignments
4.	Analytical Skills	Class room lectures, assignments
5.	Problem Solving Skills	Class room lectures, assignments
6.	Practical Skills	Examination
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. A.K. Sawhney, 2013, A Course in Electrical Machine Design, 5th Edition, Dhanpat Rai & Co. Pvt.Ltd.
3. Shanmugasundaram A., Gangadharan G., Palani R., 2018, Electrical Machine Design Data Book,

2nd Edition, New Age International Pvt. Ltd.

b. Recommended Reading

1. Alexander Grey, 2011, Electrical Machine Design: The design and specification of Direct andAlternating Current Machinery, McGraw-Hill
2. Thomas A. Lipo, 2017, Introduction to AC Machine Design, IEEE Press
3. M. V. Deshpande, 2011, Design and Testing of Electrical Machines, PHI

c. Magazines and Journals

1. IEEE – CES Transactions on Electrical Machines and Systems

d. Websites

1. http://www.springer.com/engineering/production+engineering/journal/11979
2. https://www.edx.org/
3. https://www.coursera.org/
4. nptel.iitm.ac.in/courses/IIT-MADRAS/Electrical Machine Design
5. https://ocw.mit.edu/index.html

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Course Specifications: High Voltage Engineering and Laboratory

Course Title	High Voltage Engineering and laboratory
Course Code	EEC305A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to emphasize on the basic concepts of generation and measurement of high voltageDC, AC and impulse. Students are taught conduction and breakdown mechanisms in solids, liquid and gaseousdielectrics. They are facilitated to understand causes and effects of over voltages, testing of various electrical apparatus and insulation coordination. They are also taught partial discharges and their measurement in dielectrics. Students will be able to design a suitable high voltage/current generator and test high voltage apparatus as per standards.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain causes and effects of over voltages, protection and high voltage surges in electrical powersystems
CO-2. Describe generation and measurement techniques of high DC, AC, impulse voltages and currents, testingof various high voltage apparatus
CO-3. Discuss breakdown mechanisms in gaseous, liquid, solid and composite dielectrics, applications, insulation coordination and partial discharges
CO-4. Solve simple and complex problems on breakdown strength, dielectrics and impulse voltages
CO-5. Analyze the behavior of travelling waves in transmission lines under various conditions
CO-6. Design a suitable high voltage/current generator, measurement scheme and recommend appropriateinsulation medium/material for a given application

4. Course Contents

Unit 1 (Over Voltages in Electrical Power Systems): Causes of over voltages, effects, lightning surges, switching surges, reflection and refraction of travelling waves, protection against over voltages.

Unit 2 (Conduction and Breakdown Mechanisms in Dielectrics): Gaseous breakdown in uniform and non-uniform fields, corona discharges, vacuum breakdown, conduction and breakdown in insulating liquids, breakdown mechanisms in solid and composite dielectrics, application of various insulating materials.

Unit 3 (Generation of High Voltages and High Currents): Generation of high voltage DC, AC, impulse and currents,

triggering and control of impulse generators.

Unit 4 (Measurement of High Voltages and High Currents): High series resistance with micro ammeter, dividers: resistance, capacitance and mixed dividers, peak voltmeter, generating voltmeters, capacitance voltage transformers, electrostatic voltmeters, sphere gaps, high current shunts, digital techniques in high voltage measurement, partial discharges and measurement of PD.

Unit 5 (High Voltage Testing and Insulation Coordination): Various types of High voltage tests on electrical power apparatus as per International and Indian Standards: insulators, bushing, isolators and transformers, insulation coordination.

Laboratory:

Experiment. No	Course Content
1	Measurement of HVAC subjected to air insulation using various electrode configurations and plots the graph of breakdown strength.
2	Measurements of HVDC subjected to air insulation using various electrode configurations and plot the graph of breakdown strength.
3	Breakdown strength of transformer oil.
4	Voltage withstand test on solid dielectrics under uniform field.
5	Measurement of capacitance and tan δ of different insulating materials
6	Power frequency voltage withstand test on insulator string.
7	Generation of standard impulse voltages
8	Three point and four point method measurement of earth resistance
9	Performance evaluation of numerical overvoltage/under voltage relay
10	Performance evaluation of numerical over current relay
11	Performance evaluation of motor protection relay
12	Performance evaluation of biased differential relay

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	2	3	1				1	1	3		
CO-2	3	2			3						1	1	3	1	1
CO-3	3	2	3	2	1						1	1	2		1
CO-4	3	3	3	3	3						1	1	3		
CO-5	3	2	3	2							1	1	3		
CO-6	3	2	3	2	2						1	1	3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		00
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00

1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		45

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment

4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Naidu M S and Kamaraju V, 2015, High Voltage Engineering, Tata McGraw-Hill
3. Wadhwa C L, 2013, High Voltage Engineering, New Age International Publication Ltd.

b. Recommended Reading

1. Ravindra Arora and Wolfgang Mosch, 2011, High Voltage and Electrical InsulationEngineering, John Wiley & Sons Magazines and Journals

c. Magazines and Journals

1. Magazine on "Advances in High Voltage Engineering" by IET Press
2. International Journal on High Voltage Engineering by Oriprobe/Springer
3. IEEE Electrical Insulation Magazine
4. IEEE Power Engineering Review

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Course Specifications: Engineering Economics

Course Title	Engineering Economics
Course Code	EEH301A
Course Type	Ability Enhancement Compulsory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the essentials of economics for engineers. Students are introduced to supply and demand and the basic forces that determine equilibrium in a market economy. An introduction to important macroeconomic topics is given. Students are also trained to analysethe budget and estimate costing related to electrical products.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain the concepts related to engineering decision making, time value of money, cash- flow analysis, financial accounting, budget, and project management
CO-2. Describe the factors related to microeconomics and macroeconomics
CO-3. Solve simple problems related to engineering decision making, time value of money, cash-flow analysis, financial accounting, budget, microeconomics, macroeconomics and project management
CO-4. Analyse a financial budget and interpret from economics point of view
CO-5. Develop a project management report related to an electrical product/system consideringthe financial and economic aspects

4. Course Contents

Unit 1 (Engineering Decision Making): Engineering Economics in Action, Engineering Decision Making, Making Decisions, Engineering Economics in Action, Uncertainty and Sensitivity Analysis

Unit 2 (Time Value of Money and Cash Flow Analysis): Interest and Interest Rates, Compound and Simple Interest, Effective and Nominal Interest Rates, Continuous Compounding, Cash Flow Diagrams, Equivalence: Mathematical Equivalence, Decisional Equivalence, Market Equivalence, Cash Flow Analysis: Timing of Cash Flows and Modelling, Compound Interest

Factors for Discrete Compounding, Compound Interest Factors for Single Disbursements or Receipts

Unit 3 (Depreciation and Financial Accounting): Depreciation and Depreciation Accounting, Reasons for Depreciation, Value of an Asset, Straight-Line Depreciation, Declining-Balance Depreciation, Elements of Financial Accounting: Measuring the Performance of a Firm, The Balance Sheet, The Income Statement, Estimated Values in Financial Statements, Financial RatioAnalysis

Unit 4 (Microeconomics): Applications of Supply and Demand, Demand and Consumer Behavior, Geometrical Analysis of Consumer Equilibrium, Production and Business Organization, Analysis of Costs, Production, Cost Theory, and Decisions of the Firm

Unit 5 (Macroeconomics): Overview of Macroeconomics, Measuring Economic Activity, Consumption and Investment, Business Fluctuations and the Theory of Aggregate Demand

Unit 6 (Project Management): Project Management Lifecycle: Initiation, Planning, Execution, Monitoring and Controlling, Closure; Project Management Tools: Work Breakdown Structure, Gantt Charts, The Critical Path Method Scheduling and the Critical Path Method; Dealing with Uncertainty and Risk; Case study on project management related to Electrical product andsystem

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2												1		
CO-2	2					2		2					1	2	
CO-3	2	2	1			2		2					2	2	
CO-4	2	2	1	2		3		2					2	2	
CO-5	2	2	1	2		3		2					2	2	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		05
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	04	
2. Guest Lecture	00	
3. Industry / Field Visit	00	05
4. Brain Storming Sessions	00	
5. Group Discussions	01	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignments
2.	Understanding	Classroom lectures, Assignments

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3.	Critical Skills	Classroom lectures, Assignments
4.	Analytical Skills	Classroom lectures, Assignments
5.	Problem Solving Skills	Classroom lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

5. Class Notes
6. Niall M. Fraser Elezabeth M. Jewkes (2013) Engineering Economics-FinancialDecision Making for Engineers, Pearson, Fifth edition
7. Paul A. Samuelson and William D. Nordhaus (2001), Economics, McGraw-Hill, 17th edition

b. Recommended Reading

5. Mankiw, Gergory, N (2012) Principles of Microeconomics, South Western
6. Mankiw Gregory (2008) Macroeconomics 6th edition, Palgrave

c. Magazines and Journals

4. The Economist

d. Websites

1. www.economist.com
2. www.ft.com

e. Other Electronic Resources

1. https://www.investopedia.com/university/all/economics/

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Course Specifications: Electrical Machines Laboratory-2

Course Title	Electrical Machines Laboratory-2
Course Code	EEL306A
Course Type	Laboratory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This laboratory deals with augmenting theoretical concepts of AC machines and special machines with appropriate experiments. Students will be trained to analyze performance characteristics, behavior of ACmachines and special machines. They also perform testing of AC machines.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:
CO-1. Determine performance characteristics of an AC Machine as per the standard proced
ures **CO-2.** Pre determine performance characteristics of AC machines as per the standard procedures **CO-3.** Draw the desired performance characteristics of AC Machines and Special machines
CO-4. Write laboratory report as per the prescribed format

4. Course Contents

Experiment No.	Course Content
1.	Determination of regulation by emf and mmf methods for a synchronous generator
2.	Determination of regulation by ZPF method for a synchronous generator
3.	Determination of performance characteristics of single phase induction motor by load test
4.	Determination of performance characteristics of three phase induction motor by load test
5.	Pre determination of performance characteristics of single phase induction motor
6.	Pre determination of performance characteristics of three phase induction motor
7.	Determination of Xd and Xq of a salient pole synchronous machine

8.	Synchronization of alternator with infinite bus
9.	Determination of step angle characteristics of permanent magnet machines
10.	Performance analysis of a synchronous motor under variable excitation conditions

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSO's)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1		3	2	3	2		1	3	3	2			2		3
CO-2		3	2	3	2		1	3	3	2			2		3
CO-3		3	2	3	2		1	3	3	2			2		3
CO-4											3			1	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	02	
3. Demonstration on a Computer	01	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

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The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) orsubcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
Maximum Marks ▶	25	25	50
CO-1			
CO-2			
CO-3			
CO-4			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions, experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Laboratory manual

b. Recommended Reading

1. Kothari,D.P, 2013,Electrical Machines, Tata Mc Graw Hill
2. Fitzgerald, Kingsley, Umans, 2003, Electric Machinery, 6th Ed., McGraw-Hill

c. Magazines and Journals

1. The Magazine of Electric Motor and Drive Technology
2. International Journal on Electrical Machines and Systems

d. Websites

1. https://www.edx.org/
2. https://www.coursera.org/
3. http://nptel.ac.in/
4. https://ocw.mit.edu/index.html

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Course Specifications: Control Systems Laboratory

Course Title	Control Systems Laboratory
Course Code	EEL307A
Course Type	Laboratory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

Control system laboratory deals with augmenting theoretical concepts of control systems. This course facilitates students to design, model and analyze linear control system in both time and frequency domain.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Perform stability analysis in time and frequency domain for linear control systems
CO-2. Design, model and analyze controllers and compensators for a specific application
CO-3. Obtain time and frequency response, interpret, infer, comment and draw conclusions
CO-4. Write laboratory report as per the prescribed format

4. Course Contents

Experiment No.	Course Content
1.	Mathematical Modelling of Automotive Cruise Control System
2.	Mathematical Modelling of RLC Circuit
3.	Mathematical Modelling DC Motor
4.	Block Diagram Reduction
5.	Time Response Analysis of Feedback Control Systems
6.	Design of a P Controller
7.	Design of a PID Controller
8.	Root Locus Techniques

9. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	3								3	3	

CO-2	3	3	2	2	3								3	3	
CO-3	3	3	2	2	3								3	3	
CO-4	1	2	1	1	1				1				2	1	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

10. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

11. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
Maximum Marks ▶	25	25	50
CO-1			
CO-2			
CO-3			

CO-4			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

12. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Laboratory instructions
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	--

13. Course Resources

a. Essential Reading

1. Laboratory manual
2. Rao Dukkipati, V., 2006, Analysis and Design of Control Systems Using MATLAB, New AgeInternational
3. Ashish Tewari, 2002, Modern Control Design with MATLAB and Simulink, John Wiley, New Delhi

b. Recommended Reading

1. Shahian, B., Michael Hassul, 1992, Control System Design Using MATLAB, Prentice HallInternational.

c. Magazines and Journals

1. 1. IEEE Control Systems Magazine

d. Websites

1. http://ctms.engin.umich.edu/CTMS/index.php?aux=Home
2. https://www.edx.org
3. https://www.coursera.org
4. http://nptel.ac.in
5. https://ocw.mit.edu/index.htm

Course Title	Design and Computer Aided Drawing of Electrical Machine
Course Code	EEC311A
Course Type	Core Theory Plus Laboratory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to deal with design and drawing of static and rotating electrical machines. Students are taught development of winding diagrams of DC and AC electrical machines. They are trained to developvarious cross-sectional views and create assembly diagrams. Students will be able to design and develop 3Dmodels of electrical machines using standard CAD tools.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:2
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations 23
Attendance Requirement	As per the Academic Regulations 24

3. Course Outcomes (COs)

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

CO-1. Develop DC and AC winding diagrams for rotating electrical machines
CO-2. Design and draw armature and field systems of AC and DC rotating machines
CO-3. Design and draw cross sectional view of core, yoke and windings of static and rotating electricalmachines
CO-4. Develop assembly drawing of static and rotating electrical machines
CO-5. Create 3D models of the designed electrical machines

4. Course Contents

Unit 1 (Design and Drawing of DC Machine for the Given Specifications): Develop winding diagrams of DC machines: Simplex, multiplex, double layer, lap and wave windings. Develop winding diagrams of ACmachines: Integral, fractional slot, double layer, lap and wave windings. Sectional views of yoke and field system, sectional views of armature and commutator, assembly diagram of DC machine.

Unit 2 (Design and Drawing of Alternator for the Given Specifications): Sectional views of stator and rotor,assembly diagram of alternator.

Unit 3 (Design and Drawing of a Transformer): Sectional views of single phase, three phase, core and shell type transformers.

Unit 4 (Special Purpose AC and DC Machines): Sectional views of rotary converter, shaded pole motor, repulsion motor.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	1	3	1	3	3							3	3		
CO-2	3	1	3	1	3	3							3	3		
CO-3	2	1	3	1	3	3							3	3		
CO-4	3	3	3	2	3	3							3	3		
CO-5	3	3	3	2	3	3							3	3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution																

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		55
1. Solving Numerical Problems	15	
Practical Work		10
1. Course Laboratory	10	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation	
	Component 1: CE (50% Weightage)

Subcomponent ▶			Component 2: SEE (50% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures. assignment
2.	Understanding	Classroom lectures. assignment
3.	Critical Skills	Classroom lectures. assignment
4.	Analytical Skills	Classroom lectures. assignment
5.	Problem Solving Skills	Classroom lectures. assignment
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Dr. S.K. Bhattacharya, 2015 , Electrical Engineering Drawing, New Age International

b. Recommended Reading

1. Shanmugasundaram A, R Palani, G Gangadharan, 2015, Electrical Machine Design Data Book,
   New Age International Pvt. Ltd

c. Magazines and Journals

1. IEEE Transactions on Industrial Electronics
2. IEEE Power Engineering Journal

d. Websites

1. http://www.springer.com/engineering/production+engineering/journal/11979
2. https://www.edx.org/

3. https://www.coursera.org/
4. http://nptel.ac.in/
5. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. Electronic resources on the course area are available in RUAS library

Course Specifications: Switchgear and Protection

Course Title	Switchgear and Protection
Course Code	EEC312A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to emphasize on the concept of basic electrical switchgears and protection schemes. Students are taught operation, working, applications of various switchgears and protective elements used in protection of electrical machines. They are facilitated to understand switches, fuses, various types of relays, testingof circuit breakers, grounding system. They are introduced to static and microprocessor based relays. Students willbe able to select switchgears and protecting devices for a given application.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain arc interruption theories, significance, transients, AC and DC circuit breaking and protectiverelaying

CO-2. Describe the construction, principle of operation, working, characteristics of various types of fuses,switches, protective relays, Circuit Breakers (CB) and applications

CO-3. Discuss the operating mechanism of various types of relays, protection schemes for various types of faultsin electrical machines, grounding systems, testing of CB, static and microprocessor based relays

CO-4. Solve simple problems on fuses, CBs, protective relaying, protection of electrical machines, groundingsystems

CO-5. Solve complex problems on fuses, CBs, protective relaying, protection of electrical machines, groundingsystems

CO-6. Select switchgears and protecting devices and suitable scheme for a given application

4. Course Contents

Unit 1 (Switches and Fuses): Isolating switch, load breaking switch, fuse law, cut -off characteristics, time currentcharacteristics, fuse material, HRC fuse, liquid fuse, application of fuse, problems.

Unit 2 (Principles of Circuit Breakers): Principles of ac circuit breaking, principles of DC circuit breaking, problems encountered in DC breaking, initiation of arc, maintenance of arc, arc interruption: high resistance and low resistanceinterruption, arc interruption theories: Slepian's theory and energy balance theory, re-striking voltage, recovery voltage, rate of rise of re-striking voltage, current chopping, capacitance switching, resistance switching, rating of circuit breakers, operating mechanism of breakers, auto reclosures, problems.

Unit 3 (Circuits Breakers): Construction, principle of operation, applications advantages and disadvantages of Air Circuit Breakers (ACB): air break and air blast circuit breakers, Oil Circuit Breakers (OCB): single break, double break and minimum OCB, SF6 breaker: preparation of SF6 gas, puffer and non-puffer type of SF6 breakers, vacuum circuitbreakers, problems.

Unit 4 (Testing of Circuit Breakers): Unit testing, synthetic testing, and short circuit test layout.

Unit 5 (Protective Relaying): Requirement of protective relaying, zones of protection, primary and backup protection, essential qualities of protective relaying, classification of protective relays, problems.

Unit 6 (Induction Type Relay): Non-directional and directional over current relays, IDMT and directional characteristics. Differential relay: principle of operation, percentage differential relay, bias characteristics, and distance relay, three stepped distance protection, impedance relay, reactance relay, mho relay, problems.

Unit 7 (Static and Microprocessor based Relays): Static Relays- introduction, advantages and disadvantages, microprocessor based over current relay: block diagram approach.

Unit 8 (Protection Schemes):

Generator Protection: Merz Price protection, prime mover faults, stator and rotor faults, protection against abnormal conditions, unbalanced loading, loss of excitation, over speeding, problems.

Transformer Protection: Differential protection, differential relay with harmonic restraint, inter-turn faults, Buchholz relay protection, problems.

Induction Motor Protection: Protection against electrical faults such as phase fault, ground fault, and abnormal operating conditions such as single phasing, phase reversal, over load.

Unit 9 (Grounding Systems): Ungrounded system, various grounding systems, earthing transformer, neutral grounding transformer, numerical problems.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	2						1	1	3		2
CO-2	3	3	2	2	2						1	1	3		2
CO-3	3	3	2	2	3						1	1	3		2
CO-4	3	3	2	2	2						1	1	3		2
CO-5	3	3	2	3	2						1	1	3		2
CO-6	3	3	2	3	2						1	1	3		2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		
1.Demonstration using videos	00	00
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	

Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide thefocus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures

2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Sunil S Rao, 2008, Switchgear Protection and Power Systems, Khanna Publishers
3. Badri Ram and D Vishwakarma, 2017, Power System Protection and Switchgear, 2nd Edition,McGraw Hill
4. Y G Painthankar and S R Bhide, 2007, Fundamentals of power system protection, PHI

b. Recommended Reading

1. M L Soni, P V Gupta, U S Bhatnagar and A Chakrabarti, 2009, A Text Book on Power SystemEngineering, Dhanpat Rai and Company Private Limited Websites
2. Ravindranath B and Chander M, 1977, Power System Protection & Switchgear, New AgeInternational

c. Magazines and Journals

1. Electric Power Systems Research – Journals –Elsevier

d. Other Electronic Resources

1. https://ocw.mit.edu/index.htm

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Course Specifications: Power Electronics and Drives

Course Title	Power Electronics and Drives
Course Code	EEC313A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

Course Summary This course deals with basic concepts of power electronic devices and circuits. Students are taught operation, evaluation of performance parameters and applications of AC voltage controllers, choppers, inverters and controlled rectifiers. They are facilitated to understand various commutation techniques, control of power electronic converters and their applications in electric drives.

1. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

2. Course Outcomes (COs)

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

- **CO-1.** Describe the working of various power semiconductor devices, characteristics and power converter
- **CO-2.** Explain the formation of PN junction and behavior, model, characteristics, protection, operation, firing and commutation of power electronic devices
- **CO-3.** Discuss AC voltage controllers, controlled rectifiers, DC choppers , inverters, DC and AC drives
- **CO-4.** Solve simple, complex problems on devices, commutation techniques and power converters
- **CO-5.** Analyze the performance of AC voltage controllers, controlled rectifiers, DC choppers and inverters
- **CO-6.** Design and analyze power electronic converters for a given application using standard softwaretool

3. Course Contents

Unit 1 (Power Semiconductor Devices): PN junction formation, contact potential, equilibrium fermi levels, space charge at junction, forward and reverse biased junctions: steady state conditions, current flow at a junction, Zener breakdown, avalanche breakdown, recombination and generation at junction, Ohmic losses, graded junctions, Schottky barriers, Ohmic contacts. Types of power electronic circuits, power semiconductor devices, control characteristics, peripheral effects, applications.

Unit 2 (Power Transistors): Switching characteristics, switching limits, base drive control, gate drive, di/dt and dv/dtlimitations of power MOSFET, power BJT and IGBT. Isolation of gate and base drives, design of gate and base drives.

Unit 3 (Thyristors): Types, two transistor model, characteristics, turn-on and turn-off, di/dt and dv/dt

protection. Series and parallel operation, firing circuits, design of firing circuits using UJT, op-amps and digital IC's.
Commutation Techniques: Natural commutation, forced commutation: self, impulse, resonant pulse, complementary.

Unit 4 (AC Voltage Controllers): Principle of ON-OFF and phase control, single-phase bidirectional controllers with resistive and inductive loads

Unit 5 (Controlled Rectifiers): Operating principle of phase controlled converter, single- phase semi-converters, full converters, three-phase half-wave converters, and three-phase full-wave converters

Unit 6 (DC Choppers and Inverters): Principle of step-down and step-up chopper with R-L load, classification, performance parameters, analysis of impulse commutated chopper.
Principle of operation, performance parameters, single-phase bridge inverters, three phase inverters, voltage control of single-phase inverters using single pulse width, multiple pulse width and sinusoidal pulse width modulation, current source inverters variable DC link inverter.

Unit 7 (Power Electronic Application to Drives): Speed-Torque characteristics of DC and AC motors, integration of controlled rectifier for speed control of DC and AC motor drives, introduction to chopper controlled drives.

4. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		2					1	1			3	2	1
CO-2	3	3											3		
CO-3	3	3		2									3	2	
CO-4	3	3	3	3	3				1				3	3	1
CO-5	3	3	3	3	3				1	1			3	3	1
CO-6	3	3	3	3	3		1		1				3	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

5. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		07
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	02	
3. Demonstration on a Computer	03	
Numeracy		25
1. Solving Numerical Problems	25	
Practical Work		03
1. Course Laboratory	00	
2. Computer Laboratory	03	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		70

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

8. Course Resources

a. Essential Reading

1. Course notes
2. Hart, D.W. 2013, Power Electronics, 1st Edition, Tata McGraw Hill
3. Rashid, M.H. 2013, Power Electronics, 4th Edition, Pearson, New Delhi

b. Recommended Reading

1. Net, M., Tore, M., Undeland, William, 2002, Power Electronics – Converters Applicationsand Design, 3rd Edition, John Wiley and Sons
2. Cyril L., 1993, Power Electronics, 3rd Edition, McGraw-Hill

c. Magazines and Journals

1. IEEE transaction on Power Electronics

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm

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Ramaiah University of Applied Sciences
Bangalore

Course Specifications: Power System Analysis

Course Title	Power System Analysis
Course Code	EEC314A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to understand basic concepts of stability and analysis of power systems. Students are taught power flow studies, symmetrical fault analysis, unsymmetrical fault analysis and stability analysis.They are facilitated to model and analyze transient behavior of the power system under fault condition. Theyare also trained to solve power flow equations using numerical techniques.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain various power system components, single line diagram, and various faults **CO-2.** Describe per unit system, sequence impedances and sequence networks of a power system**CO-3.** Discuss various numerical methods for solving power flow equations
CO-4. Solve simple numerical problems on per unit system, power flow methods, faults and stability in apower system
CO-5. Solve complex numerical problems on per unit system, power flow methods, faults and stability inpower system
CO-6. Analyze load flow studies, steady state stability and transient stability of a power system

4. Course Contents

Unit 1 (Representation of Power System Components): Circuit models: synchronous machines, transformer, transmission line, load, one line diagram, impedance diagram, per unit (pu) system, selection and change of base forpu quantities, pu impedance diagram.

Unit 2 (Power Flow Analysis): Significance of power flow analysis in planning and operation of power systems, statement of power flow problem, classification of buses, formation of bus admittance matrix, load flow methods: Equations, Gauss- Seidel method, Q-limit check for voltage controlled buses, acceleration of convergence, Newton-Raphson method in polar coordinates and comparison of load flow methods.

Unit 3 (Symmetrical Fault Analysis): Significance of short circuit analysis, assumptions made in fault analysis, short circuit currents and reactance of an unloaded and loaded synchronous machine, short circuit current computation, selection of circuit breakers, symmetrical fault analysis.

Unit 4 (Symmetrical Components): Symmetrical component transformation, resolution of unbalanced phasors into their symmetrical components and vice-versa, power in terms of symmetrical components, positive, negative and zero sequence impedances and sequence networks of power system elements (synchronous machine, transformerand transmission line).

Unit 5 (Unsymmetrical Fault Analysis): Unsymmetrical fault analysis using symmetrical components, Line-to-Ground (L-G), Line-to-Line (L-L), Double Line-to-Ground (L-L-G), power system with fault impedance and connections of sequence networks, open conductor faults in power.

Unit 6 (Power System Stability Analysis): Steady-state and transient stability, rotor dynamics and the swing equation, power angle equation, equal area criterion of stability, applications.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2		1	1								3		
CO-2	3	2			2								3		
CO-3	3	2											3		1
CO-4	3	1	1		1				1	1			3		
CO-5	3	2		1	2								3		
CO-6	3				2							2	3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		07
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	02	
3. Demonstration on a Computer	03	
Numeracy		25
1. Solving Numerical Problems	25	
Practical Work		03
1. Course Laboratory	03	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	

Term Tests, Laboratory Examination/Written Examination, Presentations	10
Total Duration in Hours	**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				**Component 2: SEE (50% Weightage)**
Subcomponent	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type	**Term Test-1**	**Term Test-2**	**Assignment-1**	**Assignment-2**	**100 Marks**
Maximum Marks	**25**	**25**	**25**	**25**	
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

1. Course Resources

a. Essential Reading

1. Course notes
2. Arthur Bergen, 2009, Power System Analysis, Second Edition, Pearson Education India
3. D P Kothari, 2011, Modern Power System Analysis, 4th Edition, Tata McGraw-Hill Education

b. Recommended Reading

1. W.D Stevenson, 2010, Elements of Power System Analysis, 4th Edition, New York, McGrawHill
2. L.P Singh, 2012, advanced power system analysis and dynamics, new Age International

c. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

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Course Specifications: Seminar

Course Title	Seminar
Course Code	EEP317A
Course Type	Seminar
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to train the students on data collection, analysis and presentation about a chosen topic. In this course students are required to deliver seminars on various relevant topics from the broad areas mentioned in the course content. Students will be trained to prepare a brief report on the chosen seminar topic.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Prepare and deliver seminar on a given topic.
CO-2. Write a report on the seminar topic.

4. Course Contents Indicative list of topics:

- Recent developments in electrical domain

5. Course Map (CO-PO-PSO Map)

CO	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	2	2	2	2	2	3	3	3	3	2	3
CO-2	3	3	3	2	2	2	2	2	2	3	3	3	3	2	3

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		0
Demonstrations		

1. Demonstration using Videos	00	0
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		0
1. Solving Numerical Problems	0	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		30
1. Case Study Presentation	22	
2. Guest Lecture	00	
3. Industry / Field Visit	08	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Automotive Engineering) Programme. The procedure to determine the final course marks is also presented in thePrograme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CEor SEE) or subcomponent of CE (SC1, SC2), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: Presentation (50% Weightage)	**Component 2: Report (50% Weightage)**
Maximum Marks ▸	**25**	**25**
CO-1	X	
CO-2		X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.		

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Jerry Weissman, Presenting to Win
2. Cliff Atkinson, Beyond Bullet Points
3. Bruce R. Gibrielle, Speaking Powerpoint
4. Garr Reynolds, Presentation Zen Design

b. Recommended Reading

1. Based on the topic choosen

c. Magazines and Journals

1. Based on the topic chosen, details will be shared in the class

d. Websites

1. Based on the topic chosen, details will be shared in the class

e. Other Electronic Resources

1. Relevant resources available in RUAS Library

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Course Specifications: Project Work-1

Course Title	Project Work -1/Internship
Course Code	EEP401A/EEI401A
Course Type	Project
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to give students an experience of identifying an engineering problem, conceptualise a solution, perform basic design calculations, model, solve, analyse and demonstrate its performance in a virtual environment. The students are expected to work in a team of not more than 4 members and are required to develop an appropriate solution by identifying a problem for which a better or new engineering solution is required. The team need to demonstrate the working of the solution and write a technical report. Students are required to choose a project from students projects database available. Alternatively, student can undergo internship in an industry, business organization, research organization or any other university on a topic of relevance during vacation after 6th semester with prior approval from the department head and faculty dean.

2. Course Size and Credits:

Number of Credits	06
Credit Structure (Lecture: Tutorial: Practical)	0:0:6
Total Hours of Interaction	120
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

- **CO-1.** Recognise the need for developing a new or improving an existing engineering product/system through an organised survey of literature
- **CO-2.** Define engineering design specifications
- **CO-3.** Design, model, solve, analyse the product/system to meet the design specifications
- **CO-4.** Evaluate the performance of the modelled system and justify its performance
- **CO-5.** Demonstrate the system working in a virtual environment and make a presentation
- **CO-6.** Write a technical report alternatively,
- **CO-7.** Write a report on experiences during internship
- **CO-8.** Make a presentation to a panel of examiners

4. Course Contents

Unit 1: Collection of relevant literature and review of literature

Unit 2: Interaction with the users and collection of data

Unit 3: Data Analysis, Formulation of a problem of suitable size

Unit 4: Product development planning, cost calculations

Unit 5: Detail design calculations

Unit 6: Choosing a modeling environment, learning the appropriate tools and techniques

Unit 7: Modelling, simulation and analysis of design

Unit 8: Defining performance parameters, Evaluation of performance, presentation performance characteristics, Verification of results

Unit 9: Developing a working model, testing the model and evaluating its performance Demonstration to the defined audience and making a presentation to the assessing team making a Technical presentation

Unit 10: Writing project report

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	3	2	3	1	3		3	3	3	3	3
CO-2	3	3	2	3	2	2	3	1	3		3	3	3	2	3
CO-3	2	3	3	3	2	2	3	1	3		3	3	3	2	3
CO-4	2	3	2	3	2	1	3	1	3		3	3	2	2	3
CO-5	1	1	1	3	2	1	3	1	3	3		3	1	2	3
CO-6	1	1	1	2	2	1		1	3	3		3	1		3
CO-7	1	1	1	2	2	1		1	3	3		3	1		3
CO-8	1	1			2			1	3	3		3	1		3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Approximate Duration in Hours
Literature collection, Review of literature, Deciding the sample, for data collection, Developing a questionnaire, Data collection, Analysis of data, Problem formulation and Defining specifications	20
Development of design concept, Basic design calculations	40
Selection of tools, techniques and learning on how to use them	20
Modelling, Simulation, Analysis	40
Evaluation, Verification of results	20
Demonstration, Presentation and Technical Report Writing	20

Total Duration in Hours	160

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: Presentation (50% Weightage)	**Component 2: Report (50%Weightage)**
Maximum Marks ▸	**50**	**50**
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5	X	
CO-6		X
CO-7		x
CO-8	x	
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Project Work
2.	Understanding	Project Work
3.	Critical Skills	Project Work
4.	Analytical Skills	Project Work
5.	Problem Solving Skills	Project Work
6.	Practical Skills	Project Work
7.	Group Work	Project Work
8.	Self-Learning	Project Work
9.	Written Communication Skills	Project Work
10.	Verbal Communication Skills	Project Presentation, Viva Voice

11.	Presentation Skills	Project Presentation
12.	Behavioral Skills	Project Work
13.	Information Management	Project Report
14.	Personal Management	Project Work
15.	Leadership Skills	Project Work

8. Course Resources

a. Essential Reading

1. Presentations made by the Head of the Department on "Importance of Project work and The Methodology to be followed for successful Completionof Project work"

b. Recommended Reading

1. Course Notes, Manuals of Tools and Techniques Chosen to Solve the Design Problem

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Bangalore

Course Specifications: Electronic Devices and Appliances

Course Title	Electronic Devices and Appliances
Course Code	OEE411A
Course Type	Open Elective Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to provide students the basic concepts of electronic devices and appliances. The course trains students to understand the essential principles and terminology of electronics and their implications in developing electronic devices and appliances. Students are taught to construct electronic circuits. Students are trained to test, diagnose, troubleshootand maintain an electronic device or appliance using standard tools

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:1:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain concepts of electronics and its subfields
CO-2. Apply principles of electronics to construct and analyze electronic circuits and devices
CO-3. Identify components and circuits of an electronic device/appliance at sub-circuitry level and realize its functionality
CO-4. Test electronic device/appliance functionality using appropriate tools and procedure
CO-5. Solve identified problem of an electronic device/appliance by applying standard diagnosticand troubleshooting procedure

4. Course Contents

Unit 1: Basic Terminologies of Electronics (Voltage, Current. Etc.), Passive and Active Components, Basic Circuit Theorms and Laws Of Electronics, Rectifiers, Diodes, FET, BJT, Thyristors, MOSFET and their Applications, Transforms, Voltage Regulators, Regulated Power Supplies, Oscillators and Multivibrators, Analog and Digital Filters

Unit 2: Digital Electronics and its application (logic gates, flip-flops), Digital Integrated Circuits (ICs), Timers, Amplifiers and Feedback Amplifiers, Operational Amplifiers (OPAMP) and its Applications, Sensor and Transducers, Microphones, Audio Amplifiers and Speakers, Storage Devices and Memories

Unit 3: Embedded Systems, Microprocessor and Microcontrollers Its Applications ,FPGA and its Application, Data Acquisition System and its Application, Wireless Devices and Systems, Electromechanical Switches and Relays, LED and Displays, Wires, Cables and Connectors,Battery and Battery Chargers, Test and Measuring Instruments, Waveform Generators

Unit 4: Circuit Design And Prototyping, PCB, Fundamentals diagnosis procedure and standard tools, Fundamental Trouble shooting procedure, Preventive maintains and management

Unit 5: Electronic Appliances, Working principles of few major electronic appliances (TV, Mobile Phone, Vacuum Cleaner, Microwave Oven, Refrigerator, Air Conditioning, robotic lawn mower and Washing machine, Smart watch etc.)

Unit 6: Principles of electronic medical diagnostic equipment (Digital BP meter, Ophthalmoscope, Pulse Oximeter, Vital Sign monitors etc.), Principles of medical imaging equipment (X-ray, MRI, CT, Ultrasound,PET, Fluoroscopy etc.)

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2												2		
CO-2	1	2	2										2		
CO-3	2												2		
CO-4	1		2		1								2	1	
CO-5	1	2	2	2	1								2	2	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		15
Demonstrations		06
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	04	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	30	
Practical Work		14
1. Course Laboratory	06	
2. Computer Laboratory	04	
3. Engineering Workshop / Course/Workshop / Kitchen	04	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		**10**
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures
2.	Understanding	Class room lectures, demonstrations
3.	Critical Skills	Class room lectures, Assignment
4.	Analytical Skills	Class room, Examination, Assignment
5.	Problem Solving Skills	Class room, Examination, Assignment
6.	Practical Skills	Examination, Assignment
7.	Group Work	Assignment

8.	Self-Learning	Assignment
9.	Written Communication Skills	Examination, Assignment
10.	Verbal Communication Skills	Course Work
11.	Presentation Skills	Examination
12.	Behavioral Skills	Examination, Assignment
13.	Information Management	Course Work
14.	Personal Management	Examination, Assignment
15.	Leadership Skills	Course Work

9. Course Resources

a. Essential Reading

1. Class Notes
2. Robert Diffenderfer (2005), Electronic Devices: Systems and Applications, New York, Thomson Delmar Learning
3. Russell E. Smith (2015), Electricity for Refrigeration, Heating, and Air Conditioning, 9th Edition, Stamford, Cengage Learning

b. Recommended Reading

1. Eric Kleinert (2012),Troubleshooting and Repairing Major Appliances,McGraw Hill Professional
2. Douglas Kinney (2006), ABeginners Guideto Consumer Electronics Repair:Hand Bookand Tutorial, Lincoln,iUniverse
3. Theodore F. Bogart (2004), Electronic Devices and Circuits, Sixth Edition,New Delhi, Pearson Education
4. RobinPain(1996),PracticalElectronicFaultFindingandTroubleshooting,Oxford, Newnes

c. Magazines and Journals

1. Magazine: Electronics For You
2. Journal: IEEE Transactions on Consumer Electronics
3. Journal: IEEE Transactions on Electron Devices

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Course Specifications: Project Work-2

Course Title	Project Work -2
Course Code	EEP411A
Course Type	Project
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to give students an experience of identifying an engineering problem, conceptualize a solution, perform basic design calculations, model, solve, analyse and develop a working model (preferably physical) and evaluate its performance and demonstrate its working. The students are expected to work in a team of not more than 4 members and are required to develop an appropriate solution by identifying a problem for which a better or new engineering solution is required. The team need to demonstrate the working of the solution and write a project report. Students are required to choose a project from student projects database available.

2. Course Size and Credits:

Number of Credits	12
Credit Structure (Lecture: Tutorial: Practical)	0:0:12
Total Hours of Interaction	240
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Recognize the need for developing a new or improving an existing engineering product/system through an organized survey of literature
CO-2. Define engineering design specifications
CO-3. Design, model, solve, analyse the product/system to meet the design specifications
CO-4. Evaluate the performance of the modelled system and justify its performance
CO-5. Demonstrate the system working in a virtual environment and make a presentation
CO-6. Write a project report

4. Course Contents

Unit 1: Collection of relevant literature and review of literature

Unit 2: Interaction with the users and collection of data

Unit 3: Data analysis, formulation of a problem of suitable size

Unit 4: Product development planning, cost calculations

Unit 5: Detail design calculations

Unit 6: Choosing a modeling environment, learning the appropriate tools and techniques

Unit 7: Modelling, simulation and analysis of design

Unit 8: Defining performance parameters, evaluation of performance, presentation performance characteristics, verification of results

Unit 9: Developing a working model, testing the model and evaluating its performance, demonstration to the defined audience and making a presentation to the assessing team making a technical presentation

Unit 10: Writing project report

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme SpecificOutcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	3	2	1	2	3		1	3	3	3	3
CO-2	3	3	2				1	2	3		1	3	3	2	3
CO-3	2	1	3	2	2	2		2	3		1	3	3	2	3
CO-4	2		2		2	2			3			3	2	2	3
CO-5	1	1	1		2	2			3	3		3	1	2	3
CO-6	1							2	3	3		3	1		3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Approximate Duration in Hours
Literature collection, Review of literature, Deciding the sample, For data collection, Developing a questionnaire, Data collection, Analysis of data, Problem formulation and Defining specifications	50
Development of design concept, Basic design calculations	50
Selection of tools, techniques and learning on how to use them	50
Modelling, Simulation, Analysis	50
Evaluation, Verification of results	40
Demonstration, Presentation and Technical Report Writing	20
Total Duration in Hours	260

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7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: Presentation (50% Weightage)	Component 2: Report (50% Weightage)
Maximum Marks ▸	50	50
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5	X	
CO-6		X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Project Work
2.	Understanding	Project Work
3.	Critical Skills	Project Work
4.	Analytical Skills	Project Work
5.	Problem Solving Skills	Project Work
6.	Practical Skills	Project Work
7.	Group Work	Project Work
8.	Self-Learning	Project Work
9.	Written Communication Skills	Project Work
10.	Verbal Communication Skills	Project Presentation, Viva-Voice
11.	Presentation Skills	Project Presentation
12.	Behavioral Skills	Project Work
13.	Information Management	Project Report
14.	Personal Management	Project Work
15.	Leadership Skills	Project Work

9. **Course Resources**

   a. **Essential Reading**

      1. Presentations made by the Head of the Department on "Importance of Project work and The Methodology to be followed for successful Completion of Project work"

   b. **Recommended Reading**

      1. Course Notes, Manuals of Tools and Techniques Chosen toSolve the Design Problem

Course Specifications: Power Converter Control Techniques

Course Title	Power Converter Control Techniques
Course Code	EEE311A
Course Type	Professional Core Elective
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to model using state space and transfer function. The students are taught analysis and control of various types of DC-DC converters. They are also facilitated to understand design concepts of feedback systems to control switching converters.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

1. Describe various approaches for mathematical modelling of power converters and controllers
2. Explain different control techniques, compensators and observers
3. Obtain expressions for circuit parameters to meet the design specifications
4. Model and analyze various converter circuits in frequency domain
5. Solve simple and complex problems on equivalent circuit of switch, converter, response of second order system, graphical construction of various impedance networks
6. Design and analyze the performance of controllers and regulators for various converter applications

4. Course Contents

Unit 1 (Modeling of AC Equivalent Circuit): Averaging inductor current, averaging capacitor current, circuit averaging and switch modeling, perturbation and linearization, small-signal equivalent circuit, state-space averaging, canonical model, pulse-width modulator modeling,

examples.

Unit 2 (Converter Transfer Functions 1): Design oriented analysis, review of Bode diagrams and combinations. Second-order response: resonance, low-Q approximation, analytical solution to higher-order polynomials.

Unit 3 (Converter Transfer Functions 2): Transfer functions of converters, analysis of converter using transfer functions. Graphical construction: parallel, simple and complexeimpedances, converter transfer functions.

Unit 4 (Controller Design): Effect of negative feedback on the network transfer functions, construction of closed-loop transfer functions, stability, regulator design, measurement of loopgains.

Unit 5 (Control of DC-DC converters): State space modeling of buck, buck-boost, equilibrium analysis and closed loop voltage regulation using state feedback controllers and sliding modecontrollers, application to renewable energy.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	2	2						1	3		
CO-2	3	2	3	2		1						2	3		
CO-3	3	3	3	3	1	1						2	3		
CO-4	3	3	3	3		1			1	1		2	3	3	3
CO-5	3	3	3	3					1	1		2	3	3	3
CO-6	3	3	3	3		1						2	3	3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and LearningMethods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1.Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		00

1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				**Component 2: SEE (50% Weightage)**
Subcomponent ▶□	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶□	**Term Test 1**	**Term Test 2**	**Assignment 1**	**Assignment 2**	**100 Marks**
Maximum Marks ▶□	**25**	**25**	**25**	**25**	
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning ofthe semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Robert Ericson, 2015, Fundamentals of Power Electronics, Chapman& Hall
3. Sira -Ramirez, R. Silva Ortigoza, 2006, Control Design Techniques inPower Electronics Devices, Springer
4. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, 2011, Sliding modecontrol of switching Power Converters, CRC
5. Bimal Bose, 2006, Power electronics and motor drives, Elsevier

b. Recommended Reading

1. Mohan, Undeland and Robbins, 2011, Power Electronics;Converters, Applications and Design', John Wiley and Sons
2. Erickson R W, 1997, Fundamentals of Power Electronics, Chapmanand Hall

3. Vithyathil J, 1995,Power Electronics: Principles and Applications, McGraw Hill

d. Websites

1. https://www.edx.org/
2. https://www.coursera.org/
3. http://nptel.ac.in/
4. https://ocw.mit.edu/index.htm

Course Specifications: Electrical Power Generation

Course Title	Electrical Power Generation
Course Code	EEE312A
Course Type	Professional Core Elective
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course deals with detailed study of electric power generation plants: site selection, plant layout, operation, control, safety, characteristics and maintenance. Students are taught hydel, thermal, nuclear, gas, diesel, photovoltaic, wind, tidal, biomass and geothermal power plants. The course also emphasizes on co-generation, waste to energy, bio fuels, fuel cells, energy storage systems and economic loading of power plants.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe various conventional and non- conventional power plants, energy storagesystems
CO-2. Explain the layout, components, working of various conventional plants
CO-3. Discuss the economic loading of power plants, environmental impact of conventionalpower plants
CO-4. Solve simple problems related to load duration curve and energy load curve CO-5. Solve complex problems related to load duration curve and energy load curve
CO-6. Arrive at the specifications of an appropriate power plant for a given generationcapacity

4. Course Contents

Unit 1 (Sources of Electrical Power Generation): Wind, solar, fuel cell, tidal, geo-thermal, hydroelectric, thermal, diesel, gas, nuclear, co-generation, combined cycle power generation, distributed generation.

Unit 2 (Hydro Power Station): Selection of site, classification, general arrangement, operation, structure, pumped storage, control and environmental impact.
Unit 3 (Thermal Power Station): Selection of site, cost, components, operation, plant layout, working, adverse effects of fossil fuels
Unit 4 (Nuclear Power Station): Selection of site, cost, components of plant, description of fuel sources, components of reactor, safety of nuclear power reactor, disposal of nuclear waste and environmental impact.
Unit 5 (Diesel Power Station): Components, selection of site, necessity, characteristics, plant layout,maintenance and environmental impact.
Unit 6 (Gas Turbine Plant): Classification, components, plant layout, environmental impact, advantages, comparison with steam turbine plant.
Unit 7 (Economic Loading): Terms commonly used in system operation, diversity factor, load factor, plant capacity factor, plant use factor, plant utilization factor, loss factor, load duration curve, energyload curve, interconnection of power station, problems on economic loading.
Unit 8 (Renewable Energy Sources): Wind, solar- photo voltaic, solar thermal, mini and micro hydro, biomass, bio-fuels, tidal, ocean, geothermal, fuel cell, Magneto Hydro Dynamic (MHD) system, co- generation power plants, Waste to Energy (WtE).

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3					2	2						3	2	
CO-3	3					2	2						3	2	
CO-4	3	2				2	2						3	2	
CO-5	3	3				2	2						3	2	
CO-6	3					2	2					1	3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	01	

2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electricaland Electronics Engineering) Programme. The procedure to determine the final course marks is alsopresented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginningof the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Chakrabarti A. , Soni M.L., Gupta P.V., Bhatnagar, 2013, PowerSystem Engineering, Dhanpat Rai & Co. (P) Ltd.

b. Recommended Reading

1. Manoj Kumar Gupta, 2012, Power Plant Engineering, Delhi, PHILearning Pvt. Ltd.
2. Derbal L F and Boston P G, 1996, Power Plant Engineering, Springer
3. P K Nag, 2001, Power Plant Engineering, New Delhi, McGraw Hill

c. Magazines and Journals

1. Journal of Electric Power Generation
2. Power magazine
3. Energy-Tech Magazine

d. Websites

1. www.power-eng.com/
2. https://mnre.gov.in/
3. https://www.edx.org/
4. https://www.coursera.org/
5. http://nptel.ac.in/
6. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. Electronic resources on the course area are available in RUAS library

Course Specifications: Advanced Control System

Course Title	Advanced Control Systems
Course Code	EEE313A
Course Type	Professional Core Elective
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to deal with non-linear control techniques to analyze and solve control system engineering problems. Students are taught the concepts of describing function, phase plane analysis, and model-reference for designing nonlinear and adaptive control system. Students are trained to model, simulate and analyze non-linear control techniques for given applications using software tools.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe the impact of nonlinearities and stability on controller design
CO-2. Discuss the principles of state space analysis describing function, singularpoints and chaos in non-linear control system

CO-3. Model, simulate and analyze various nonlinearities of a plant Designcontrollers and compensators for given specifications

CO-4. Design controller for non-linear system using describing function and phaseplane approaches and perform stability studies

CO-5. Model and simulate nonlinear controller for a given application and analyzetime response, steady state error and stability of the system

4. Course Contents

Unit 1 (Non-linear Systems): Types of non-linearity, examples of non-linear systems and their importance

Unit 2 (Mathematical Modelling of Systems): Generalized Eigen vectors, controllability and observability, state transition matrix basics of state space design: design of controller and observer,full order and reduced order observer, pole placement techniques.

Unit 3 (Describing Function Analysis): Common nonlinearities and their describing functions, designof controllers for nonlinear system using DF method, reliability, compensation.

Unit 4 (Phase Plane Analysis): Phase portraits, singular points, limit cycles, exact, input-state and input-output linearization.

Unit 5 (Stability Analysis): Absolute, zero-input, BIBO, and Lyapunov's stability, constructionof Lyapunov's functions, stability of perturbed systems.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2			1						3	2	0
CO-2	3	3	3	3	3		2						3	3	0
CO-3	3	3	3	3	3	3		1			2	2	3	3	2
CO-4	3	3	3	3	2	3	3		3	1	1	2	3	3	3
CO-5	3	3	3		2				1	1			3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	01	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (50% Weightage)	

Subcomponent ▶			Component 2: SEE (50% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning ofthe semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Gopal M., 2002, Control Systems: Principles and Design, 3rd Ed., TataMcGraw-Hill.
3. Alessandro Astolfi, Dimitris Karagiannis, Romeo Ortega, 2008, Nonlinear and Adaptive Control with Applications, Springer

b. Recommended Reading

1. Khalil, H., 2001, Non-linear Systems. 3rd Edition, Prentice Hall
2. Wiggins, S., 2003, Introduction to Applied Non-linear DynamicalSystem and Chaos, 2nd Edition, Springer

c. Magazines and Journals

1. IEEE transaction on control systems technology
2. IEEE transaction on automatic control
3. International Journal on Advanced Control of Electrical Systems-Elsevier

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. https://ocw.mit.edu/index.htm

Course Specifications: Industrial Drives and Applications

Course Title	Industrial Drives and Applications
Course Code	EEE411A
Course Type	Professional Core Elective
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to appraise the basic concepts of various electrical drive topologies and their dynamics. Students are taught selection of AC and DC drives based on their mode of operation, power rating, speed torque characteristics and speed control. They are facilitated to understand thebehavior of AC and DC drives under transient conditions. They are also trained to analyze the performance of electric drives under steady state and transient conditions using standard software tools.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0

Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe block diagram, dynamics, speed torque characteristics of electricdrives
CO-2. Explain the transient behavior of electric drives, loss reduction techniques andinduction motor drive configurations
CO-3. Discuss and analyze the speed control of various AC and DC drive topologies
CO-4. Solve simple and complex problems on AC and DC drives
CO-5. Select suitable rating of motor used in an electric drive for a given application

4. Course Contents

Unit 1 (Dynamics of Electric Drives): General concepts, choice of electrical drives, block diagram, advantages, status of DC and AC drives, transient conditions, forces and torques acting in electric drives, referring load torques, moment of inertia, forces and translating masses to rotating shaft, acceleration and deceleration time.

Unit 2 (Speed Torque Characteristics of Electrical Drives): Speed-Torque characteristics of industrial equipment and electric motors, joint torque speed characteristics of motor and load, speed-torque characteristics: DC shunt motor, DC series motor, induction motor, synchronous motor under motoringand braking condition.

Unit 3 (Speed Control of Electric Drives): Fundamental parameters of speed control, speed control of DC shunt motor, DC series motor, induction motor, induction motor: Scherbius and Kramers drives.

Unit 4 (Transient Conditions in Electric Drives): Shunt wound dc motor start-up, braking energy undertransient process, starting and braking in adjustable voltage system, DC series motor drives, three- phase induction motor drives, reduction of losses under transients.

Unit 5 (Selection of Motor for Drives): Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)	Programme Specific Outcomes (PSOs)

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

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		10
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and

Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.
The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)
Subcomponent ▶			
Subcomponent Type ▶	Terms Tests	Assignments	100 Marks
Maximum Marks ▶	50	50	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning ofthe semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--

13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. M Hughes. A, D. William, 2016, Electric Motors and Drives: Fundamentals, Types and Applications, 4th Edition, newness
3. Ned Mohan, 2012, Electric Machines and Drives,1st Edition, JohnWiley
4. G.K Dubey, 2010, Fundamentals of Electrical Drives, 2ndEdition, Narosa publishing house, Chennai

b. Recommended Reading

1. N.K De and P.K. Sen, 2007, Electrical Drives, PHI Publication House
2. S.K Pillai, 1990, A First Course On Electric Drives, Wiley Eastern Ltd
3. V.R. Moorthi, 2005, Power Electronics, Devices, Circuits andIndustrial Applications, Oxford University Press

c. Magazines and Journals

1. IEEE transaction on Industrial Electronics

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm

Course Specifications: Power System Operation and Control

Course Title	Power System Operation and Control
Course Code	EEE412A
Course Type	Professional Core Elective
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to understand basic concepts of power system control and economic operation. Students are taught unit commitment, economic dispatch, real and reactive power control. They are facilitated to understand the concepts of smart grid. They are also trained to designand model FACTS power controllers and compensators.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	45
Number of Weeks in a Semester	16
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain basic concepts in power system operation and control, unit commitment, economicdispatch, smart grid
CO-2. Describe various mechanisms of real and reactive power control
CO-3. Discuss various FACTS devices and their applications, conventional and smart grid
CO-4. Solve simple problems on economic dispatch, unit commitment real, power-frequencycontrol, reactive power voltage control
CO-5. Solve complex numerical problems on unit commitment, economic dispatch, real power-frequency control, reactive power voltage control, FACTS devices
CO-6. Model and analyze FACTS devices for a given application using standard software tool

4. Course Contents

Unit 1 (Basics in Power System Control): Operational objective of a power system, issues of ownership and co-ordination, definition of various operating states, hierarchical control, significance, constraints in power system operation, optimization, various types of equipment, generator constraints, transmission line constraints, generator capability curves, typical rating of synchronous generator, angular stability, verification of power capability curve for a generator using standard software tool.

Unit 2 (Unit Commitment and Economic Dispatch): Formulation of economic dispatch problem, I/O cost characterization, incremental cost curve, co-ordination equations without and with loss, solution by direct method and λ-iteration method, unit commitment: priority-list method and forwarddynamic programming.

Unit 3 (Real Power-Frequency Control): Basics of speed governing mechanism and modeling, regulating characteristics, load sharing between two synchronous machines in parallel , control area concept, LFC with and without integral controller for single area and two-area systems, tie line frequency bias control, integration of economic dispatch control with LFC.

Unit 4 (Reactive Power-Voltage Control): Generation and absorption of reactive power, reactive power control, modeling and analysis of excitation systems; FACTS devices: SVC, TCR, TSC, STATCOM, shunt and series compensators, comparison between SVC and STATCOM.

Unit 5 (Smart Grid): Evolution of electric grid, smart grid: concept, definitions, need, drivers, functions,opportunities, challenges and benefits.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	2						1	1	3	2	1
CO-2	3	3	2	2	2						1	1	3	2	1
CO-3	3	3	2	2	3						1	1	3	3	1
CO-4	3	3	2	2							1	1	3	2	1
CO-5	3	3	2	3							1	1	3	3	1
CO-6	3	3	2	3	2						1	1	3	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

5. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		10

1.Demonstration using Videos	03	
2. Demonstration using Physical Models / Systems	05	
3. Demonstration on a Computer	02	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			

CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning ofthe semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

8. Course Resources

a. Essential Reading

1. Course notes
2. Arthur Bergen, 2009, Power System Analysis, Second Edition,Pearson Education India

3. D P Kothari, 2011, Modern Power System Analysis, 4th Edition, TataMcGraw-Hill Education

b. Recommended Reading

1. W.D Stevenson, 2010, Elements of Power System Analysis, 4thEdition, New York, McGraw Hill
2. L.P Singh, 2012, advanced power system analysis and dynamics, newAge International

c. Magazines and Journals

1. https://www.journals.elsevier.com/electric-power-systems-research/
2. http://www.sciencedirect.com/science/journal/03787796
3. IEEE Transactions on Smart Grid

d. Websites

1. http://utubersity.com/
2. https://www.edx.org/
3. https://www.coursera.org/
4. http://nptel.ac.in/
5. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm

Course Specifications: Soft Computing

Course Title	Soft Computing
Course Code	EEE413A
Course Type	Professional Core Elective
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to understand different soft computing technologies and its applications. Students are taught principles of membership functions of fuzzy logic controllers, learning schemes of neural network and concepts of genetic algorithm. Modeling, simulation and analysis of neural, fuzzy, and genetic algorithm based controllers are emphasized.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Understand Soft Computing concepts, technologies, and applications
CO-2. Explain the concepts of Fuzzy logic, neural networks, Genetic Algorithm and their importance in non-linear and adaptive control systems
CO-3. Model, simulate and analyze membership functions of Fuzzy logic controllers and learning schemes of neural network for their implementation
CO-4. Identify, evaluate and select an appropriate control law for a given application and develop a schematic diagram for its implementation
CO-5. Model, design, simulate and analyze the control laws using Fuzzy logic and neural controllers
CO-6. Apply different soft computing techniques for real world applications

4. Course Contents

Unit I (Artificial intelligence systems): Neural networks, fuzzy logic, genetic algorithms. Artificial neural networks: Biological neural networks, model of an artificial neuron, Activation functions, architectures, characteristics-learning methods, brief history of ANN research-Early ANN architectures (basics only)- McCulloch & Pitts model, Perceptron, ADALINE, MADALINE

Unit II (Back propagation networks): architecture, multilayer perceptron, back propagation learning-input layer, hidden layer, output layer computations, calculation of error, training of ANN, BP algorithm, momentum and learning rate, Selection of various parameters in BP networks. Variations in standard BP algorithms- Adaptive learning rate BP, resilient BP, Levenberg-Marquardt, and conjugate gradient BP algorithms (basic principle only)-Applicationsof ANN

Unit III (Fuzzy Logic): Crisp & fuzzy sets – fuzzy relations – fuzzy conditional statements – fuzzy rules – fuzzy algorithm. Fuzzy logic controller – fuzzification interface – knowledge base – decision making logic - defuzzification interface – design of fuzzy logic controller – case studies.

Unit IV (Genetic algorithms): Basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Elitism. Inheritance operators, Crossover different types, Mutation, Bit-wise operators, Generational cycle, Convergence of GA, Applications of GA – case studies. Introduction to genetic programming- basic concepts.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3		2					1	1			3			
CO-2	3	3											3			
CO-3	3	3											3			
CO-4	3	3	3		2				1	1			3			
CO-5	3	3	3		2				1	1			3	3	1	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution																

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		

1. Solving Numerical Problems	30	

Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	00
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50% Weightage)		**Component 2: SEE (50% Weightage)**
Subcomponent ▶			
Subcomponent Type ▶	**Terms Tests**	**Assignments**	**100 Marks**
Maximum Marks ▶	**50**	**50**	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shallprovide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

e. Essential Reading

1. Course notes
2. Gang Feng (2010) Analysis and Synthesis of Fuzzy Control Systems: A Model-Based Approach, Kindle edition
3. Hung,T., Nguyen, Nadipuram,R., Prasad Carol,L., Walker, Elbert,A., Walke r(2002) A First Course in Fuzzy and Neural Control ,Chapman and HALL/CRC Publication
4. L. Fausett, Fundamentals of Neural Networks, Prentice Hall, Upper Saddle River, N.J, 1994.

f. Recommended Reading

1. D. E. Goldberg, Genetic Algorithms in Search, Optimisation, and MachineLearning, Addison-Wesley, Reading, MA, 1989
2. M. T. Hagan, H. B. Demuth, and M. H. Beale, Neural Network Design, PWSPublishing, Boston, MA, 1996.
3. T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill, NewDelhi, 1995

4. J. R. Koza, Genetic Programming: On the Programming of Computers byNatural Selection, MIT Press, Cambridge, 1992.

g. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

Course Specifications: Modelling and Control of Power Electronics System

Course Title	Modelling and Control of Power Electronics System
Course Code	EEE421A
Course Type	Professional Core Elective
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to augment the basic concepts of converter modelling and control. Students are taught various modelling and linear control techniques of power converters. They are also trained to simulate and analyze power converters for various applications using standard software tool.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

- **CO-1.** Explain various methods of modelling and control of power converters
- **CO-2.** Discuss linear control techniques for power electronic converters. Describe various methods to improve power quality
- **CO-3.** Obtain mathematical model for various configurations of DC – DC converters
- **CO-4.** Develop a control strategy for a given power electronic converter model
- **CO-5.** Solve simple and complex numerical problems on modelling and control ofpower electronic converters
- **CO-6.** Model, simulate and analyze power converters for various applications usingstandard software tool

4. Course Contents

Unit 1 (Modelling of Power Electronic Converters): Power electronic converters modelling, scopeof modelling. Model types: switched, sampled - data, averaged, large signal, small signal and behavioral models.

Unit 2 (Switched Model and Classical Averaged Model): Mathematical modelling: general mathematical frame work, bilinear form, basic assumptions, state variables, general algorithm. sliding average, state variable average, average of switch, complete power electronic circuit average. Averaging methodologies: graphical approach and analytical approach. Small signal averaged model: continuous small signal averaged model and sampled data small signal averagedmodel.

Unit 3 (Generalized and Reduced Order Averaged Model): Methodology of averaging: analyticalapproach and graphical approach. Relation between generalized averaged models.

Unit 4 (Modelling of DC-DC Power Converters): Buck converter, boost converter, buck – boost converter, boost – boost converter, cuk converter, zeta converter and SEPIC converter.

Unit 5 (Control of Power Electronic Converters): Introduction to general control principles of power electronic converters, specific control issues related to power electronic converters.

Unit 6 (Linear Control Techniques for Power Electronic Converters): Introduction to linear control, design methods, direct and indirect output control, converter control using dynamic compensationby pole placement

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3		2						1	3	3	1
CO-2	3	3	2	2		1						2	3	2	2
CO-3	3	3	2	2		1						2	3	2	2
CO-4	3	3	3	3		1			1	1		2	3	3	2
CO-5	3	3	3	3	1				1	1		2	3	3	2
CO-6	3	3	3	3	3	1						2	3	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1.Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	

3. Demonstration on a Computer	03	

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Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of Cos on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				**Component 2: SEE (50% Weightage)**
Subcomponent ▶□	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶□	**Term Test**	**Term Test**	**Assignment**	**Group Task**	**100 Marks**
Maximum Marks ▶□	**25**	**25**	**25**	**25**	
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning ofthe semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course Notes
2. Seddik Bacha, Iulian Munteanu, AntonetaIulianaBratcu, 2014, Power Electronic Converters Modeling and Control, Springer, UK

b. Recommended Reading

1. Chen, Wen-Wei, Chen, Jiann-Fuh, 2018, Control Techniques forPower Converters with Integrated Circuit, Springer
2. HeberttSira-Ramírez and Ramón Silva-Ortigoza, 2006, Control DesignTechniques in Power Electronics Devices, Springer, London
3. Ned Mohan, 2014, Advanced Electric Drives: Analysis, control andmodeling using MATLAB/Simulink, Wiley, USA

4. Ned Mohan, Undeland and Robbins, 2010, Power ElectronicsConverters, Applications and Design, Wiley
5. Robert W. Erickson, 2001, Fundamentals of Power Electronics, Kluwer academic publisher, USA

c. Magazines and Journals

1. IEEE Transactions on Power Electronics
2. IEEE Journal of Emerging and Selected Topics in Power Electronics
3. CSEE Journal of Power and Energy Systems
4. IEEE Power and Energy Magazine
5. IET Power Electronics

d. Websites

1. https://www.edx.org/
2. https://www.coursera.org/
3. http://nptel.ac.in/
4. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. Electronic resources on the course area are available on RUAS library

Course Specifications: Testing and Commissioning of Electrical Equipment

Course Title	Testing and Commissioning of Electrical Equipment
Course Code	EEE422A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with Generators, Transformer, Motors and Breakers Testing and commissioning confirming to BIS and other applicable standards. The students are taught different standards to be referred for testing and commissioning of Electrical equipment beingfollowed in the industries, students are taught different equipments used for testing the electrical equipments. Students are exposed to testing and commissioning of major equipments.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Describe the theoretical workings of various electrical equipments
CO-2. Discuss different testing methods adopted in power systems
CO-3. Discuss how to commission high voltage equipments in distribution processes
CO-4. Perform efficiency and regulation tests and determine mechanical stress under normaland abnormal conditions
CO-5. Model a system as per BIS standards used in testing and commissioning
CO-6. Formulate a real-world testing and commissioning of approach to meet Standards, types, specification, installation, commissioning tests, maintenance schedule, type& routine tests

4. Course Contents

Unit 1(Transformers):

a. Specifications: Power and distribution transformers as per BIS standards.

b. Installation: Location, site, selection, foundation details (like bolts size, their number, etc), code of practice for terminal plates, polarity & phase sequence, oil tanks, drying of windings and general inspection.

c. Commissioning tests: Following tests as per national & International Standards, volt ratio test, earth resistance, oil strength, Buchholz & other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index, load & temperature rise test.

d. Specific Tests: Determination of performance curves like efficiency, regulation etc, and determination of mechanical stress under normal &abnormal conditions.

Unit 2(Synchronous Machines):

a. Specifications: As per BIS standards.

b. Installation: Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out.

c. Commissioning Tests: Insulation, Resistance measurement of armature & field windings, waveform& telephone interference tests, line charging capacitance.

d. Performance tests: Various tests to estimate the performance of generator operations, slip test, maximum lagging current, maximum reluctance power tests, sudden short circuit tests, transient & sub transient parameters, measurements of sequence impedances, capacitive reactance, and separation of losses, temperature rise test, and retardation tests.

e. Factory tests: Gap length, magnetic eccentricity, balancing vibrations, bearing performance

Unit 3 (Induction Motors):

a. Specifications for different types of motors, Duty, I.P. protection.

b. Installation: Location of the motors (including the foundation details) & its control apparatus, shaft& alignment for various coupling, fitting of pulleys & coupling, drying of windings.

c. Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations& balancing.

d. Electrical Tests: Insulation test, earth resistance, high voltage test, starting up, failure to speed upto take the load, type of test, routine test, factory test and site test (in accordance with ISI code

e. Specific Tests: Performance & temperature raise tests, stray load losses, shaft alignment, and re-rating & special duty capability.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		2			2	1	1	1	2	3	3	2	3
CO-2	3	3	3	3	3		2						3	3	0
CO-3	3	3	3	3	3	3		1			2	2	3	3	2
CO-4	3	3	3	3	2	3	3		3	1	1	2	3	3	3
CO-5	3	3	3		2				1	1			3	2	1

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3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		04
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		21
1. Solving Numerical Problems	21	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in thefollowing Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ▶	SC1	SC2	SC3	SC4	
Subcomponent Type ▶	Term Test 1	Term Test 2	Assignment 1	Assignment 2	100 Marks
Maximum Marks ▶	25	25	25	25	
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shallprovide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes

2. S Rao (2012), Testing Commissioning Operation and Maintenance of ElectricalEquipments,
3. Thomas Elliot, Kao Chen and Robert Swanekamp. (2010) Standard Handbook ofPower

a. Plant, Engineering, McGraw Hill. **Recommended Reading**
   1. Transformer & Switch Gear Handbook -Transformers-BHEL, J &P

b. **Magazines and Journals**

c. **Websites**
   1. www.nbppl.in (accessed on 18th January 2012)
   2. Ministry of Power-Govt. of India
   3. Ministry of New and Renewable Energy Sources-Govt. of India
   4. Planning Commission- Govt. of India

d. **Other Electronic Resources**
   Electronic resources on the course area are available on RUAS library

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Course Specifications: PLC and SCADA

Course Title	PLC and SCADA
Course Code	EEE423A
Course Type	Core Theory
Department	Electrical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to apprise recent developments in industrial automation: PLC, SCADA, HMI and DCS. Students are taught PLC architecture and relevant programming languages. They are trained to design and build automated system for various industrial applications. They are also introduced to SCADA and DCS systems.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO-1. Explain the need for automation, SCADA systems, PLC and programming languages, IoT, DCS, MMI
CO-2. Describe PLC architecture and logic implementation
CO-3. Discuss SCADA system and various real time applications
CO-4. Discuss DCS architecture and various distributed control applications
CO-5. Develop control logic for industrial automation using PLC program language and SCADA
CO-6. Automate a given manual process and experimentally validate the developed control logic

4. Course Contents

Unit 1 (Industrial automation, Programmable Logic Controllers (PLC): difference between relay, contactor. PLC programming languages: ladder logic, FB, STL. SCADA systems: system monitoring, supervisory control, data acquisition, MMI, DCS, IoT.

Unit 2 (Programmable Logic Controllers): PLC architecture, PLC modules and cards, development of ladder logic: coils, NO/NC, set, reset, timers, counters, comparison, arithmetic, logical and move functions, jump call and routine functions. PLC scan, communication options, hardware faults. Applications of PLC programming.

Unit 3 (SCADA): SCADA systems, hardware and firmware, SCADA systems software and protocols SCADA and the Internet, modems, central site computer facilities and its security, SCADA system in load dispatch center. Case studies: SCADA applications in power generation plants.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3					2	2						3	2	
CO-2	2	2	3										3		
CO-3				3		2							3	2	
CO-4				2	3	2							2	3	
CO-5	2	3	3	2	2	2							3	2	
CO-6	2	2	3	3	2	3							3	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

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Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Electrical and Electronics Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CEor SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

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	Component 1: CE (50% Weightage)				**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test-1**	**Term Test-2**	**Assignment-1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**25**	**25**	**25**	**25**	
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shallprovide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
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3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. W.Bolton, Programmable Logic Controllers, 2015, Elsevier Publication
3. John Webb, W., Ronald Reiss, A., Programmable Logic Controllers – Principleand Applications, Fifth Edition, PHI
4. David Lindsley, Power Plant Control and Instrumentation, 2005, CambridgeUniversity Press
5. David Bailey, Edwin Wright, 2003, Practical SCADA for Industry, Australia, Elsevier Publication

b. Recommended Reading

1. M.C. Horsley, Process Plant Commissioning: a user guide, 2002, Institution ofChemical Engineers
2. Hackworth, JR., Hackworth , F.D, Jr., 2005, Programmable Logic Controllers,Programming Method and Applications, Pearson,

c. Magazines and Journals

1. IEEE Transactions on Robotics and Automation

2. IEEE Transactions on Automation Science and Engineering

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. PLC and SCADA trainer kit
2. Electronic resources on the course area are available in RUAS library

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