

Programme Specifications

M. Tech. Programme



Programme: Power Electronics and Drives

Department: Electrical Engineering

**Faculty of Engineering and
Technology**

**M. S. Ramaiah University of Applied
Sciences** University House, New BEL Road, MSR Nagar,
Bangalore – 560 054 www.msruas.ac.in

Programme Specification

Programme: M. Tech. in Power Electronics and Drives	
Faculty	Engineering and Technology
Department	Electrical Engineering
Programme	M.Tech
Dean of Faculty	Dr. M. Arulanantham
HOD	Dr. K. Manickavasagam

	1. Title of the Award
	M. Tech. in Power Electronics and Drives
	2. Modes of study
	Full Time
	3. Awarding Institution / Body
	M. S. Ramaiah University of Applied Sciences – Bengaluru, India
	4. Joint Award
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	5. Teaching Institution
	Faculty of Engineering & Technology
	M S Ramaiah University of Applied Sciences - Bengaluru, India
	6. Date of Programme Specification
	May 2019
	7. Date of Programme Approval by the Academic Council of MSRUAS
	July 2019
	8. Next Review Date
	May 2021
	9. Programme Approving Regulatory Body and Date of Approval
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	10. Programme Accrediting Body and Date of Accreditation
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	11. Grade Awarded by the Accreditation Body
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	12. Programme Accreditation Validity
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	13. Programme Benchmark
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14. Rationale for the Programme	
	<p>Power electronics is a key enabling, dynamic technology that has seen an exponential growth in the recent past due to the demand from several new applications like desalination plants, painting vehicles, testing rail cars, power units for aerospace, marine and automotive systems. This requires an accelerated capacity building with relevant knowledge and skills in the domain to provide customized power electronic solutions for various industrial sectors.</p> <p>The depletion of fossil fuels and its undesirable impact on the environment has led to a worldwide mandate for promotion of Renewable Energy Systems and rapid penetration of E-mobility in the transportation sector. These have built in efficient power electronic energy conversion systems and electrical machines. The converters help in efficient harnessing of energy from renewable sources to operate as a standalone micro-grid or as a grid integrated system. Innovative energy storage technologies and power management techniques are very essential for integration and deployment of renewable energy systems and they also play a major role in electric vehicles.</p> <p>Karnataka state government has taken initiative by bringing in the “Karnataka Electric Vehicles & Electric Storage Policy 2017”, that proposes to establish working groups and research facilities with supporting grants for development of necessary customized technologies from concept to market. The proposal is oriented to address the key concerns of electric vehicle technologies and battery technologies in view of development of smart micro-grids.</p> <p>Power semiconductor switching devices inject harmonics into the system. Power electronic devices like SVC, UPFC, IPFC and SSSC are exploited, to mitigate power quality issues, to improve the voltage stability, steady state and transient stabilities of a complex power system. Power semiconductor devices are used in converter topologies for control of electric drives, HVDC transmission systems, and to suppress EMC/EMI in power electronic systems. Switching power supplies, dc-dc converters, inverters, power factor correction converters and LED lighting drivers employ high-frequency switching circuits to convert and condition electrical power. Power converters and their control play a major role in handling the system to improve the efficiency and ecology.</p> <p>The need of the hour is the availability of skilled design engineers with a good understanding of the circuits, their control systems and magnetics to actively participate in multidisciplinary teams in the industry and R&D organizations.</p>

15. Programme Aim

The aim of the programme is to enhance the professional competency of postgraduates by imparting advanced knowledge and understanding of Power Electronics and Drives (PED); critical thinking, problem solving techniques, analytical and transferable skills. The programme emphasises on modelling, analysis, synthesis and development of power electronics and drives. The students will be able to acquire skills in designing, developing, testing of power electronic systems and their interaction with externally connected components or systems using advanced simulation tools.

16. Programme Objectives

The programme introduces the concepts of power electronic converters and electric drives. Students will be able to apply the knowledge, understanding and skills acquired to design, simulate, analyze, synthesize and evaluate various topologies for a given application. It is structured to enable the students to build power electronic controllers for specific applications, analyze power quality issues, electromagnetic interference and compatibility using standard tools. Emphasis will be placed on critical thinking and innovative problem solving approaches in the domain of power electronics and drives.

The objectives of the programme are to enable the students to:

1. Explicate the operation of power electronic converters, electric machines and variable speed drives
2. Analyze, model, design, and develop power converter based energy conversion systems
3. Design, simulate and synthesis controllers for PED systems using simulation tools
4. Implement, test and validate designed power electronic converters and drives
5. Analyze Electromagnetic interference and compatibility issues in power electronic converters
6. Develop competency to test and validate power electronic systems for real-time application
7. Pursue opportunities and build a career in industries

17. Intended Learning Outcomes of the Programme

The Intended Learning Outcomes (ILOs) are listed under four headings:

1. Knowledge and Understanding, 2. Cognitive Skills 3. Practical Skills and 4. Capability / Transferable Skills.

1. Knowledge and Understanding

After undergoing this programme, a student will be able to:

- KU1:** Explain various power electronic converter topologies
- KU2:** Describe various design aspects of power electronic drive systems
- KU3:** Describe the importance of electromagnetic compatibility in power electronic systems
- KU4:** Explain the power system for aerospace, marine and automotive applications

2. Cognitive Skills

After undergoing this programme, a student will be able to:

- CS1:** Design and analyze various topologies for electric drives
- CS2:** Arrive at design specifications of solar and wind energy conversion systems
- CS3:** Apply finite element analysis to a given electric drive system
- CS4:** Model and analyze power electronic systems used in smart grid

3. Practical Skills

After undergoing this programme, a student will be able to:

- PS1:** Use software tools for simulation of motors and drives

- PS2:** Use finite element tools to design and analyze electrical drives
- PS3:** Critical analysis for the choice of power semiconductor devices for an application
- PS4:** Test the performance of designed power converters for a given application

4. Capability / Transferable Skills

After undergoing this programme, a student will be able to:

- TS1:** Manage information, develop technical reports and make presentations
- TS2:** Build, Manage and Lead a team to successfully complete a project and communicate across teams and organizations to achieve professional objectives
- TS3:** Work under various constraints to meet project targets
- TS4:** Adopt to the chosen profession by continuously upgrading his/her knowledge and understanding through Life-long Learning philosophy

18. Programme Structure

The Programme consists of four terms as shown below. A student is required to successfully complete the following courses and earn credits for the award of the degree.

Complete details of each of the courses such as ILO's, content, resources, teaching-learning processes and other related information are outlined in Course Specification of the respective programme.

SEMESTER 1

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19PEC501	Modern Power Semi conductor Devices	3	2	--	5	100
2	19PEC502	Electric Drive Systems	3	2	--	5	100
3	19PEC503	Power Converters Analysis and Design	3	1	1	5	100
4	19PEC504	Power Electronic Control of Drives	3	1	1	5	100
5	19FET508A	Research Methodology & IPR	2	--	--	2	50
6	19FET509A	Professional Communication	1	--	--	0	
Total			15	06	02	22	550
Total number of contact hours per week			23 hours				
Number of credits can be registered			Minimum	18	Maximum	22	

SEMESTER 2

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19PEC505	Power Electronics in Renewable Energy Systems	3	1	1	5	100
2	19PEC506	Finite Element Analysis of Electric Drives	3	1	1	5	100
3	19PEE51X	Digital Control of Power Electronic Systems/ Electric Drive Vehicle Engineering	3	--	--	3	100
4	19PEE51X	Smart Grid Technologies/ Intelligent Control Systems in Electric Vehicles	3	--	--	3	100
5	19PEE52X	Power Systems for Aerospace, Marine and Automotive Applications/ Embedded Systems for EV	3	--	--	3	100
6	19PEE52X	Power Quality/ Energy Storage Systems	3	--	--	3	100
9	19FET510A	Value Education	1			0	
Total			19	02	02	22	600
Total number of contact hours per week			23 hours				
Number of credits can be registered			Minimum	18	Maximum	22	

19. Programme Delivery Structure

A Programme is delivered from Monday to Saturday of the week as per the Time-Table for every batch

SEMESTER 3

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19PEP521A	Internship			10	4	100
2	19PEP522A	Group project			15	8	200
3	19STP523A	Dissertation and Publication Phase 1					
Total					25	12	300
Total number of contact hours per week			XX hours				
Number of credits can be registered			Minimum	XX	Maximum	XX	

SEMESTER 4

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19PEP523A	Dissertation and Publication Phase 2			24	24	400
Total					24	24	400
Total number of contact hours per week			24 hours				
Number of credits can be registered			Minimum	24	Maximum	24	

Elective Courses List		
Stream / Specialization	Course Code	Course Title
Stream -1/ Power Electronic control and Applications	19PEE511	Digital Control of Power Electronic Systems
	19PEE512	Power Quality
	19PEE513	Power Systems for Aerospace, Marine and Automotive Applications
	19PEE514	Smart Grid Technologies
Stream-2/ Power Electronics in Electric Vehicles	19PEE521	Electric Drive Vehicle Engineering
	19PEE522	Energy Storage Systems
	19PEE523	Embedded Systems for EV
	19PEE524	Intelligent Control Systems in Electric Vehicles

20. Teaching and Learning Methods

The course delivery comprises of a combination of few or all of the following:

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

8. Group Exercises
9. Project Exhibitions
10. Technical Festivals

21. Courses

Programme has six Professional core courses , four Professional elective courses , two audit courses, and one compulsory course followed by Group Project, Internship and Dissertation & Publication courses.

Core courses are Programme Specialization courses which normally include both theory and laboratory sessions. Alternate activities are planned in case of laboratory sessions do not exist in a course.

Compulsory course is Research Methodology and IPR course which is mandatory.

All courses of the programmes are categorized as indicated in the **Annexure I**.

22. Electives

There are 4 electives in the programme. The electives are grouped such a way that a student can choose a set of electives to specialize in a chosen field/stream. However, if the student wishes to opt for elective course that spans multiple streams, the case may be considered subject to the affordability of academic logistics and approval by the course leader, HODs and Deans.

For every elective offered, there will be a minimum and a maximum number of registrations that is decided by the department.

There is also a provision for the students to choose two courses through on-line mode such as MOOC's, SWAYAM, NPTEL and other equivalent platforms. The guidelines prescribed by the University for such courses to be adhered to. The student can also earn 3 or 4 credits by participating in the international competitions like technical presentation/ conference/ publications in the journal etc and winning the award in that. In that case he/she can be exempted from one of the elective courses of the programme.

23. Group Project

The main objective of group project is to provide an ambiance to work in groups towards achieving a common goal. A group shall have up to 5 students. In case of Group Project work is based on interdisciplinary in nature, team can be constituted with members from across departments of the Faculty.

The students are required to develop a report for assessment and also need to demonstrate the working of the product. The IPR rights of all such work lies with the University only. The project should be approved by a committee constituted by respective HoDs before the start of the project. For further details related to the Group Project refer to Course Specification of the respective programmes

24. Industry Internship/Other Activities

A student can opt for an internship in an industry, a business or research organization during the course.

Alternately, can undertake a mini-project requiring self-directed study that can be perused within the affiliated Faculty.

Prior approval of the internship / mini-project by the HoD and Dean is mandatory. It is also necessary for the student to submit a report and make a presentation to the members of the panel constituted by the HoD for assessment.

For further details related to this course, please refer to Course Specification of the respective programmes.

25. Dissertation and Publication

This course has two parts – Dissertation and Publication.

Every student, has to undertake the dissertation work individually on a chosen relevant topic. The topic needs to be approved by the committee constituted by HoD.

Publication is a stage wherein dissertation work of the student is converted into a technical paper to be published in reputed conferences/journals.

For further details related to the this course refer to Course Specifications of the respective programmes

26. Course Assessment

- a. Every course will be assessed for a weight of 100%
- b. There are two components-Component-1 and Component-2
- c. Component-1 carries a weight of 50% and Component -2 carries a weight of 50%

ILO No.	Intended Learning Outcome	CE (Weightage: 50 %)				SEE
		Assessment Type	Comp-1a	Comp-1b	Comp-1c	(Weightage: 50 %)
		Comp Weightage (%)	00	00	00	Sem End Exam
1	ILO-1					
2	ILO-2					
3	ILO-3					
4	ILO-4					
5	ILO-5					
6	ILO-6					

- d. For courses with a combination of theory and laboratory

ILO No.	Intended Learning Outcome	CE (Weightage: 50 %)				SEE
		Assessment Type	Comp-1a	Comp-1b	Comp-1c Lab	(Weightage: 50 %)
		Comp Weightage (%)	00	00	00	Sem End Exam
1	ILO-1					
2	ILO-2					
3	ILO-3					
4	ILO-4					
5	ILO-5					
6	ILO-6					

A student is required to score a minimum of 40% in each of the components and an overall 40% for successful completion of a module and earning the credits.

27. Failure in Course and Makeup Examinations

Makeup Examinations are provided for the students who are not able to meet all pass criteria prescribed for a course during the regular term and fail in the course.

For further details related to makeup examination, please refer to M.Tech. Programme Academic Regulations document.

28. Attendance

Please refer to M.Tech. Programme Academic Regulations document for attendance requirements and condonation related details.

29. Award of Grades

As per the M.Tech. Programme Academic Regulations document.

30. Student Support for Learning

Students are provided with various facilities to support learning such as the following:

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

31. Quality Control Measures

Following are the Quality Control Measures:

1. Review of course notes
2. Review of question papers and assignment questions
3. Student Feedback Analysis
4. Moderation of assessed work
5. Opportunities for the students to see their assessed work
6. Review and audit by external experts
7. Staff Student Consultative Committee meetings
8. Student exit feedback analysis
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

32. Curriculum Map

Course Code	Intended Learning Outcomes											
	Knowledge and Understanding				Cognitive (Thinking) Skills (Critical, Analytical, Problem Solving, Innovation)				Practical Skills			
	KU1	KU2	KU3	KU4	CS1	CS2	CS3	CS4	PS1	PS2	PS3	PS4
19PEC501	X		X		X						X	
19PEC502		X			X				X			X
19PEC503	X				X						X	X
19PEC504		X			X				X			X
19FET509A												
19FET510A												
19PEC505	X					X		X				X
19PEC506			X				X			X		
19PEE511		X			X				X			X
19PEE512	X				X						X	X
19PEE513				X	X						X	
19PEE514	X							X				X
19PEE521				X	X				X			
19PEE522	X					X					X	
19PEE523		X			X				X			
19PEE524				X	X				X			
19FET520A	X	X	X	X	X	X	X	X	X	X	X	X
19PEP521A	X	X	X	X	X	X	X	X	X	X	X	X
19PEP522A	X	X	X	X	X	X	X	X	X	X	X	X
19PEP523A	X	X	X	X	X	X	X	X	X	X	X	X

33. Capability / Transferable Skills Map

Course Code	Group work	Self-learning	Research Skills	Written Communication Skills	Verbal Communication Skills	Presentation Skills	Behavioural Skills	Information Management	Personal management/ Leadership Skills
19PEC501		X	X	X		X			
19PEC502	X	X	X	X		X			
19PEC503	X	X	X	X		X			
19PEC504	X	X	X	X		X			
19FET509A	X	X		X	X	X		X	
19FET510A		X	X	X	X	X		X	
19PEC505	X	X	X	X		X			
19PEC506	X	X	X	X		X			
19PEE511	X	X	X	X		X			
19PEE512	X	X	X	X		X			
19PEE513	X	X	X	X		X			
19PEE514	X	X	X	X		X			
19PEE521	X	X	X	X		X			
19PEE522	X	X	X	X		X			
19PEE523	X	X	X	X		X			
19PEE524	X	X	X	X		X			
19FET520A	X	X		X	X	X	X	X	X
19PEP521A	X	X		X	X	X	X	X	
19PEP522A	X	X	X	X	X	X	X	X	X
19PEP523A		X	X	X	X	X	X	X	X

34. Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposium, paper writing, attending industry exhibitions, project competitions and related activities to enhance their knowledge and network.

35. Cultural and Literary Activities

To remind and ignite the creative endeavors, annual cultural festivals are held and the students are made to plan and organize the activities.

36. Sports and Athletics

Students are encouraged to develop a habit of taking part in outdoor and indoor games on regular basis.

