University of Mumbai

No. AAMS_UGS/ICC/2022-23/ 113

CIRCULAR :-

Attention of the Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science & Technology is invited to this office circular No.UG/137 of 2016-17 dated 9th November, 2016 relating to the revised syllabus of M.E.(Power Electronics and Drives) (Sem.– I to IV) (CBCS) (REV-2022 Scheme).

They are hereby informed that the recommendations made by the Board of Studies in Electrical Engineering at its meeting held on 09th May, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 23rd June, 2022 vide item No. 6.22 (R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 **vide** item No. 6.22 (R) and that in accordance therewith, the revised syllabus of M.E.(Power Electronics and Drives) (Sem.– I to IV) (CBCS) (REV-2022 Scheme) has been brought into force with effect from the academic year 2022-23. (The circular is available on the University's website www.mu.ac.in).

(Dr. Shailendra Deolankar)
I/c Registrar

MUMBAI – 400 032
20th October, 2022

To

The Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science & Technology.

A.C/6.22(R)/11/07/2022

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No. AAMS_UGS/ICC/ 2022-23/ 113 20th October, 2022

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology.
2) The Chairman, Board of Studies in Electrical Engineering.
3) The Director, Board of Examinations and Evaluation.
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

(Dr. Shailendra Deolankar)
I/c Registrar

Desktop/Circular of Engineering/Priya

Copy to :-

1. **The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
2. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
5. **The Deputy Registrar, Executive Authorities Section (EA),**
6. **The Deputy Registrar, PRO, Fort, (Publications Section),**
7. **The Deputy Registrar (Special Cell),**
8. **The Deputy Registrar, Fort/Vidyanagari Administration Department (FAD) (VAD), Record Section,**
10. **The Professor-cum- Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

1. **P.A. to Hon'ble Vice-Chancellor,**
2. **P.A. to Pro-Vice-Chancellor,**
3. **P.A. to Registrar,**
4. **All Deans of all Faculties,**
5. **P.A. to Finance & Account Officer, (F. &. A.O.),**
6. **P.A. to Director, Board of Examination & Evaluation,**
7. **P.A. to Director, Innovation, Incubation and Linkages,**
8. **P.A. to Director, Board of Lifelong Learning and Extension (BLLE),**
9. **The Director, Dept. Of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
10. **The Director of Board of Student Development,**
11. **The Director, Department of Students Welfare (DSD),**
12. **All Deputy Registrar, Examination House,**
13. **The Deputy Registrars, Finance & Accounts Section,**
14. **The Assistant Registrar, Administrative sub-campus Thane,**
15. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
16. **The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri,**
17. **The Assistant Registrar, Constituent Colleges Unit,**
18. **BUCTU,**
19. **The Receptionist,**
20. **The Telephone Operator,**
21. **The Secretary MUASA,**

for information.

AC – 11/07/2022
Item No. – 6.22 (R)

University of Mumbai

Revised Syllabus for
M.E. (Power Electronics and Drives)

(Semester – I to IV)

(Choice Based Credit System)

(With effect from the academic year 2022-23)

University of Mumbai

Syllabus for Approval

O:_____ Title of Course	M.E. (Power Electronics and Drives)
O:_____ Eligibility	After Completing Graduation in Engineering as per the Ordinance 0.6243
R:_____Passing Marks	45%
No. of years/Semesters:	Years- 2 / Semesters - 4
Level:	P.G.
Pattern:	Semester
Status:	Revised
To be implemented from Academic Year:	From the academic year 2022-23

Dr. Sushil Thale
Chairman,
Board of Studies in
Electrical Engineering

Dr. Suresh K. Ukarande
Associate Dean,
Faculty of Science and
Technology

Dr Anuradha Majumdar
Dean,
Faculty of Science and
Technology

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self-learning. Therefore, in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self-learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Master of Engineering in Electrical Engineering (Power Electronics and Drives) from the academic year 2022-23.

Signature: **Signature:**

Chairman, Board of Studies **Faculty of Dean**

Program Structure for
M.E. Electrical Engineering (Power Electronics and Drives)
University of Mumbai
(With Effect from 2022-2023)
Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
PEDC101	Electrical Drives and its Application	3	--	--	3	--	--	3
PEDC102	Power Electronic Converters	3		--	3		--	3
PEDPE101X	Program Elective 1	3	--	--	3	--	--	3
PEDPE102X	Program Elective 2	3	--	--	3	--	--	3
PEDIE101X	Institute Elective 1	3	--	--	3	--	--	3
PEDL101	Drives And Control Lab	--	2	--	--	1	--	1
PEDSBL101	Skill Based Lab-I Power Electronics Design Lab-I	--	4$	--	--	2	--	2
Total		**15**	**06**	**--**	**15**	**03**	**--**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
PEDC101	Electrical Drives and Application	20	20	20	80	3	--	--	100
PEDC102	Power Electronic Converters	20	20	20	80	3	--	--	100
PEDPE101X	Program Elective 1	20	20	20	80	3	--	--	100
PEDPE102X	Program Elective 2	20	20	20	80	3	--	--	100
PEDIE101X	Institute Elective 1	20	20	20	80	3	--	--	100
PEDL101	Drives And Control Lab	--	--	--	--	--	25	25	50
PEDSBL101	Skill Based Lab-I Power Electronics Design Lab-I	--	--	--	--	--	50	50	100
Total		**--**	**--**	**100**	**400**	--	**75**	**75**	**650**

Subject Code	Program Elective Course-1	Subject Code	Program Elective Course-2
PEDPE1011	Machine Learning Techniques in Power System	PEDPE1021	Digital Signal Controller
PEDPE1012	Power Quality in Power System	PEDPE1022	Micro-grid Technology
PEDPE1013	Electric Vehicle Technology	PEDPE1023	IoT application in Electrical Engineering

Program Structure for
M.E. Electrical Engineering (Power Electronics and Drives)
University of Mumbai
(With Effect from 2022-2023)
Semester II

Course Code	Course Name	Teaching Scheme(Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
PEDC201	Advanced Power Electronics	3	--	--	3	--	--	3
PEDC202	Digital Control of Electrical Drives	3		--	3		--	3
PEDPE201X	Program Elective 3	3	--	--	3	--	--	3
PEDPE202X	Program Elective 4	3	--	--	3	--	--	3
PEDIE201X	Institute Elective 2	3	--	--	3	--	--	3
PEDL201	DSP Applications Lab	--	2	--	--	1	--	1
PEDSBL201	Skill Based Lab-II Power Electronics Design Lab-II	--	4$	--	--	2	--	2
Total		**15**	**06**	**--**	**15**	**03**	**--**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
PEDC201	Advanced Power Electronics	20	20	20	80	3	--	--	100
PEDC202	Digital Control of Electrical Drives	20	20	20	80	3	--	--	100
PEDPE201X	Program Elective 3	20	20	20	80	3	--	--	100
PEDPE202X	Program Elective 4	20	20	20	80	3	--	--	100
PEDIE201X	Institute Elective 2	20	20	20	80	3	--	--	100
PEDL201	DSP Applications Lab	--	--	--	--	--	25	25	50
PEDSBL201	Skill Based Lab-II Power Electronics Design Lab-II	--	--	--	--	--	50	50	100
Total		**--**	**--**	**100**	**400**	--	**75**	**75**	**650**

Note 1: Skill Based Lab- I and II are focused on the learning through experience. SBL shall facilitate the learner to acquire the fundamentals of practical engineering in his or her specialization in a project-oriented environment. The learning through skill based labs can be useful in facilitating their research work and hence useful in early completion of their dissertation work.

Subject Code	Program Elective Course-3	Subject Code	Program Elective Course-4
PEDPE2011	Power Electronics in Power Systems	PEDPE2021	Design of Electric Vehicle System
PEDPE2012	Industrial Load Modeling and Control	PEDPE2022	Design of Power Electronic Converters
PEDPE2013	DSP Applications in Power Conversion Systems	PEDPE2023	Power Converters for Renewable Energy Sources

Program Structure for
M.E. Electrical Engineering (Power Electronics and Drives)
University of Mumbai
(With Effect from 2022-2023)
Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
XXMP301	Major Project: Dissertation -I	--	20	--	--	10	--	10
Total		**00**	**20**	**00**	**00**	**10**	**--**	**10**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
XXMP301	Major Project: Dissertation -I	--	--	--	--	--	100	--	100
Total		**--**	**--**	**--**	**--**	--	**100**	**--**	**100**

Online Credit Courses

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
XXOCC301	Online Credit Course - I	--	--	--	--	--	--	3
XXOCC301	Online Credit Course - II	--	--	--	--	--	--	3
Total		**--**	**--**	**--**	**00**	**00**	**00**	**06**

Note 2: It is mandatory to complete the Online Credit Courses (OCC) available on NPTEL / Swayam /MOOC or similar platform approved by UoM. These two courses shall be completed in any semester I or II or III, but not later end of the Semester III. University shall make a provision that credits earned with OCC- I and OCC-II shall be accounted in the third semester grade-sheet with actual names of courses. The learner shall be allowed to take up these courses from his or her institute or organisation/ industry where his / her major project is carried out. The students shall complete the courses and shall qualify the exam conducted by the respective authorities/ instructor from the platform. The fees for any such courses and the corresponding examination shall be borne by the learner.

Online Credit Course – I
The learner shall opt for the course in the domain of Research Methodology **or** Research & Publication Ethics or IPR. The opted course shall be of 3 credits of equivalent number of weeks.

Online Credit Course –II

The learner shall opt for the course recommended by Faculty Advisor/ Project Supervisor from the institute. The opted course shall be of 3 credits of equivalent number of weeks.

Program Structure for
M.E. Electrical Engineering (Power Electronics and Drives)
University of Mumbai
(With Effect from 2022-2023)
Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
XXMP401	Major Project: Dissertation -II	--	32	--	--	16	--	16
Total		--	32	--	--	16	--	16

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
XXMP401	Major Project: Dissertation -II	--	--	--	--	--	100	100	200
Total		--	--	--	--	--	100	100	200

Note 3: The Dissertation-II submission shall not be permitted till the learner completes all the requirements ME course.

Note 4: The contact hours for the calculation of load of the teacher for Major Project are as follows:
Major Project Dissertation I and II - 02 Hour / week / student

Institute Electives #

Subject Code	Institute Elective Course-I	Subject Code	Institute Elective Course-II
PEDIE1011	Product Lifecycle Management	PEDIE2011	Project Management
PEDIE1012	Reliability Engineering	PEDIE2012	Finance Management
PEDIE1013	Management Information System	PEDIE2013	Entrepreneurship Development and Management
PEDIE1014	Design of Experiments	PEDIE2014	Human Resource Management
PEDIE1015	Operation Research	PEDIE2015	Professional Ethics and CSR
PEDIE1016	Cyber Security and Laws	PEDIE2016	Research Methodology
PEDIE1017	Disaster Management and Mitigation Measures	PEDIE2017	IPR and Patenting
PEDIE1018	Energy Audit and Management	PEDIE2018	Digital Business Management
PEDIE1019:	Development Engineering	PEDIE2019	Environmental Management

 # Common with all branches

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDC101	**Electrical Drives and Application**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDC101	**Electrical Drives and Application**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	**To impart knowledge on** 1. Modelling and control of various machines 2. Electric Drives in various applications
Course Outcomes	**Upon successful completion of this course, the learner will be able:** 1. To develop mathematical model of an electrical machine. 2. To analyse scalar control schemes of induction motor. 3. To analyse vector control schemes of induction motor. 4. To analyse the control of PMSM, SyRM and BLDC motors. 5. To identify the motors, power modulators and the control schemes used in various applications.

Module	**Details**	**Hours**
1	**Electrical Machine Modelling:** Modelling of DC Machine: Voltage and Torque equations, Time domain block diagram of DC shunt Machine, Modelling of AC Machine: Three Phase to Two Phase Transformation, Inverse Transformation, commonly used Reference Frames. Voltage and Torque equations, Dynamic model of Induction Machine.	08
2	**Scalar Control of Induction Motor:** Variable voltage and Variable Frequency Operation of Three Phase Symmetrical Induction Machine, Drive Operating Regions, Different Scalar Control Schemes with block diagrams (Voltage fed Inverter Control and Current fed Inverter Control)	06
3	**Vector Control and Direct Torque Control of Induction Motor:** Introduction, Direct or Feedback Vector Control, Flux Vector Estimation, Indirect or Feed Forward Vector Control, Stator Flux Oriented Vector Control, Sensorless Vector Control, Direct Torque and Flux Control (DTC), Adaptive Control: MRAC, Fuzzy logic control	08
4	**Control of PMSM, BLDC Motor and Synchronous Reluctance Motor (SyRM):** PMSM: V/Hz control, Self-Control Model, Vector control, Speed Control of BLDC Motor. Construction details and speed control of SyRM	06
5	**Domestic and Industrial Applications:** Domestic applications of Drives and Control: Ceiling fan with single phase induction motor/BLDC motor, Refrigerator, Washing Machine, Air Conditioner, Mixer grinder. Industrial Application: Drives in Cement factory, Steel Industry, Rolling Mills, Pumps, Blower Fans, Conveyors, Cranes and Lifts	06
6	**Electrical Drives in Electric Vehicle Applications:** Block Diagram of a typical EV powertrain. Power/Energy Supply Requirements for EV applications, Machines used for Propulsion Applications and Basic Control Schemes - Induction Motor, PMSM, BLDC motor, SyRM, SRM.	05

Text Books:-

1. Modern Power Electronics and A.C. Drives, B. K. Bose, Prentice Hall PTR.
2. Electric Motor Drives: Modeling, Analysis and Control, Krishnan.R, PHI.
3. First Course on Electrical Drives by S. K. Pillai, New Age International
4. Electrical Drives: Concepts and Applications by Vedam Subramanyam, T.M.H

Reference Books:-

1. Analysis of Electric Machinery P.C. Krause, McGraw Hill, New York
2. Power Semiconductor Controlled Drives, G. K. Dubey, Prentice-Hall International.
3. D. W. Novotny and T. A. Lipo, Vector Control and Dynamics of AC Drives, Oxford University Press, 1996.
4. Power Electronics by Muhammad H. Rashid, Pearson
5. Control of Electrical drives, W. Leonhard, Springer-Verlag.
6. John Chiasson, Modelling and High Performance Control of Electric Machines, Wiley- IEEE Press, 2005.
7. I. Boldea, S. A. Nasar, Vector Control of AC Drives, CRC Press, 1992.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDC102	**Power Electronic Converters**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDC102	**Power Electronic Converters**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. To understand and acquire knowledge about various power semiconductor devices related to its characteristics, ratings, protection and to select semiconductor devices for various applications. 2. To introduce different methods of power conversion such as ac to dc, dc to dc, dc to ac the underlying principles of converter operation and hence to analyze different converter circuits for power conversion. 3. To keep abreast with the latest technologies and research going on in different areas related to power electronics. 4. To enhance the capability of problem solving skills.
Course Outcomes	**Upon successful completion of this course, the learner will be able to** 1. Select and design power electronic converter topologies for a broad range of energy conversion applications. 2. Ability to analyze various single phase and three phase power converter circuits and understand their applications. 3. Apply the basic concepts of power electronics to design the circuits in the fields of AC and DC drives, power generation and transmission and energy conversion, industrial applications, extraction of energy from renewable sources. 4. Determine the drive circuit requirements in terms of electrical isolation and design heat sink, snubber circuit for protection

Module	**Details**	**Hours**
1	**Power Semiconductor Devices** Review of Power Devices: SCR, BJT, MOSFET, IGBT, Safe operating Limits, selection of devices for various applications, Conduction and Switching losses, numericals, Wide band gap devices (WBC): SiC, GaN devices.	07
2	**Drive Circuits and Protection:** Gate drive requirements, Types of driver circuits, Driver ICs, Driver circuit requirements for WBC devices. Protection circuits: Snubber circuits and its design, temperature control and heat-sinks, numericals.	06
3	**DC to DC Converters** Analysis of various conduction modes of 2^{nd} order converters: Buck, Boost, Buck-Boost converters, Introduction to 4^{th} order converters: Cuk and SEPIC converters in CCM, waveforms, output voltage derivation, comparison of dc to dc converters, numericals, Introduction to interleaved dc-dc converters.	08
4	**Power factor and power decoupling in Rectifiers** Causes for poor power factor in diode rectifiers, effect of power factor on firing angle in thyristor rectifiers, Single phase PWM rectifiers and its applications, Power factor improvement using DC-DC converters.	06

	Need for power decoupling in single phase rectifiers, single phase power decoupling techniques in rectifiers.	
5	**DC to AC Converters and Modulation Strategies:** Output waveforms of single and Three phase VSI, blanking/dead time requirement, harmonic analysis of load voltage, Current source inverters, comparison of VSI and CSI, numericals.	06
6	**PWM Modulation Strategies**: Single phase Sinusoidal PWM (unipolar, bipolar), effect of amplitude and frequency modulation index, Hysterisis PWM, Three phase SPWM, Space vector modulation.	06

Text Books:

1. N. Mohan, T. M. Undeland, W.P Robbins, Power Electronics, Converters, Applications & Design, Wiley India Pvt. Ltd.
2. M. H. Rashid, Hand book of Power Electronics", Academic Press,2001.
3. Daniel.W.Hart, "Power Electronics", Mc Graw Hill Publications 2010.
4. Joseph Vithayathil, Power Electronics, Tata McGraw Hill.
5. P.S Bhimbra, "Power Electronics", Khanna Publishers.
6. Simon Ang, Alejandro Oliva, "Power-Switching Converters" Taylor and Francis group
7. R W Erickson and D Maksimovic, Fundamental of Power Electronics Springer, 2nd Edition.

References/Journals

1. P. T. Krein, Elements of Power Electronics, Oxford University Press.
2. L. Umanad, "Power Electronics: Essentials & Applications," Wiley.
3. IEEE Transaction journals, IECON, APEC and other power electronic related Conference Proceedings etc.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ME (Electrical Engineering) in Power Electronics and Drives- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE1011	**Machine Learning Techniques in Power System**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE1011	**Machine Learning Techniques in Power System**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. Understand the motivation for different machine learning algorithms and select the appropriate algorithm for a given problem 2. Use the backpropagation algorithm to calculate weight gradients in a feed forward neural network by hand 3. Write a machine learning algorithm from scratch using Python libraries, and analyse its performance.
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach. 2. Illustrate the importance of Decision tree algorithms in machine learning 3. Analyse and implement various machine learning approaches and paradigms using python libraries. 4. Extract features that can be used for a particular machine learning approach in various applications in electrical engineering.

Module	**Details**	**Hours**
1	**Introduction to machine learning:** Impact in daily lives. Brief history of Machin learning. Machine learning techniques: Supervised, Unsupervised, Reinforcement, Neural Network. Train and test methodology, Issues in Machine Learning, Overfitting, Machine learning versus Artificial Intelligence , Ethics in AI, Introduction to Python, Libraries for Machine learning.	04
2	**Decision Tree:** Introduction, Decision tree representation, appropriate problems for decision tree learning, basic decision tree algorithm, hyperspace search in decision tree learning, issues in decision tree learning.	06
3	**Supervised Learning:** Regression, Linear Regression, Multilinear Regression, Logistic Regression, Best fit line, Decision Line, Regression model in Python.	06
4	**Clustering & Unsupervised Learning:** Learning from unclassified data. Clustering, Hierarchical Agglomerative Clustering. K-means clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labelled and un-labelled data, clustering model in Python.	08
5	**Artificial Neural Network:** Introduction, Feed Forward Neural Networks, basic neural network structure, The Perceptron, forward propagation, cost functions, nonlinear function, Multilayer network.	09
6	**Back propagation Algorithm and Applications:** backpropagation, error, training by gradient descent, bias/variance and under/overfitting, regularization, ANN model in	06

	Python, Applications of machine learning in electrical engineering: smart grid, renewable energy generation, Forecasting.	

Text Books:

1. Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Mueller, Sarah Guido, Published by O'Reilly Media, Inc.
2. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.
3. Neural Network Design, Second Edition, Martin T. Hagan, Howard B. Demuth, Mark Hudson Beale, and Orlando De Jesús, 2014.

Reference Books:

1. Introduction to Machine Learning, By Ethem Alpaydin
2. Neural Networks a Comprehensive Foundations, Simon S Haykin, PHI Edition,

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE1012	**Power Quality in Power System**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE1012	**Power Quality in Power System**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	**To impart knowledge on** 1. Various power quality issues, it causes and effects 2. Effects of harmonics due to non-linear load 3. Mitigation methods for harmonics
Course Outcomes	**Upon successful completion of this course, the learner will be able to** 1. Identify various power quality issues, its causes and effects. 2. Identify and analyse the harmonics created due to nonlinear load. 3. Analyse the power factor compensation for linear and nonlinear loads. 4. Understand various power quality mitigation techniques. 5. Identify various power quality issues in distributed generation system. 6. Understand power quality measuring equipment and monitoring standards

Module	**Contents**	**Hours**
1	**Introduction:** Sources and Effects of power quality problems, types of power quality disturbances - Voltage sag (or dip), Swell, Transients, short duration voltage variation, long duration voltage variation, voltage imbalance, waveform distortion, and voltage flicker.	06
2	**Fundamentals of Harmonics:** Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads, Locating Harmonic Sources, System Response Characteristics, Effects of Harmonic Distortion, Inter-harmonics	06
3	**Power Quality Evaluation:** IEEE guide lines, Standards and recommended practices, Harmonics mechanism of harmonic generation, harmonic indices (THD, TIF, DIN, C – message weights) Power Quality Costs Evaluation, Harmonic sources, Switching devices, arcing devices, saturable devices. Effects of Power System, harmonics on Power System equipment and loads.	06
4	**Power Factor Compensation in linear circuits:** Linear circuits with Sinusoidal Supply-Basic relationship, complex power, apparent power, power factor and power factorcompensation Linear circuits with non-Sinusoidal Supply-Basic relationship, complex power, apparent power, power factor and power factorcompensation.	06
5	**Power Factor Compensation in non-linear circuits:** Non-Linear circuits with Sinusoidal Supply-Basic relationship, complex power, apparent power, power factor and power factor compensation. Non-Linear circuits with non-Sinusoidal Supply-Basic relationship, complex power, apparent power, power factor and power factor compensation.	07

6	**Power Quality Mitigation Techniques:** Passive Filters, Shunt Active Filters, Series Active Filters, Unified Power Quality Compensators	08

Text Books:

1. Roger C. Dugan, Mark F. McGranaghan and H.Wayne Beaty, —Electrical Power System Quality, MC Graw Hill
2. G.T. Heydt, Electric Power Quality, Stars in a Circle Publications
3. J. Arrillaga, N.R. Watson and S. Chen, Power System Quality Assessment, John Wiley & Sons
4. W. Shepherd and P. Zand, Energy flow and power factor in non-sinusoidal circuits, Cambridge University Press
5. IEEE-519: 1992, IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
6. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, Power Quality: Problems and Mitigation Techniques, John Wiley & Sons, First Edition 2015

Reference Book/Journals:

1. Jos Arrillaga, B.C. Smith, Neville R Watson and A.R. Wood, Power System Harmonics Analysis, Wiley 1997
2. Math H.J. Bollen, Understanding Power Quality Problems, Voltage Sag and Interruptions, Wiley-IEEE Press
3. Selected research papers in IEEE Transactions on Power Systems, IEEE Transactions on Power Delivery, and IEEE Transaction on Power Quality

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE1013	**Electric Vehicle Technology**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Subject code	**Subject Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE1013	**Electric Vehicle Technology**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	To impart knowledge on 1. Know the history of electric hybrid electric vehicles (EV & HEV) and 2. emphasize the need and importance of EV-HEV for sustainable future. 3. Introduce the fundamental concepts and principles of electric and hybrid electric vehicles drive train topologies. 4. Develop a thorough understanding of the key elements of EV/HEV: Electric Machines for Propulsion Applications and Energy Sources 5. Model, analyze and design electric and hybrid electric vehicles drive train and to understand energy management strategies
Course Outcomes	Upon successful completion of this course, the learner will be able: 1. To identify and describe the history and evolvement of electric & hybrid electric vehicles to emphasize on the need and importance of EV/HEV for sustainable future. 2. To identify and describe the principles of various EV/HEVs drive train topologies along with their power flow control and fuel efficiency estimation. \ 3. To design and select electric propulsion system components for EV/HEV drives suitability for the desirable performance and control. 4. To compare and evaluate various energy sources and energy storage components for EV and HEV applications. 5. To model, analyze and design EV/HEV drive train with energy management strategies. 6. To recognize the need to adapt and engage in operations EV/HEV with the absolute technological change in the transportation system for sustainable future.

Module	**Contents**	**Hours**
1	**Introduction:** Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Historical background of EV/HEV. Current state of the art in EV/HEV technology.	05
2	**Hybrid Electric Vehicles:** History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drivetrain topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	08
3	**Electric Drive Trains:** Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles; Configuration and control: BLDC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives; drive system efficiency.	07

4	**Energy Storage:** Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles; Energy storage and its analysis: Battery, Fuel Cell, Super Capacitor and Flywheel, Hybridization of different energy storage devices.	06
5	**Energy Management Strategies:** Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	04
6	**Design of EV/HEV:** Tractive Effort calculation, Sizing the drive system: Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Design considerations for a Hybrid Electric Vehicle (HEV), Design considerations for Battery Electric Vehicle (BEV).	09

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, Hybrid Electric Vehicles: Energy Management Strategies, Springer, 2015.
4. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2004.
5. T. Denton, —Electric and Hybrid Vehicles, Routledge, 2016

Reference books:

1. I. Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Sheldon Williamsom, Energy Management Strategies for Electric and Plug-in Hybrid Vehicles, Springer 2013
3. J. Larminie and J. Lowry, Electric Vehicle Technology Explained, Wiley, 2003
4. Robert A. Huggins, Energy Storage, Springer 2010

Website Reference:

1. http://nptel.iitm.ac.in: Introduction to Hybrid and Electric Vehicles - Web course

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE1021	**Digital Signal Controller**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE1021	**Digital Signal Controller**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. To impart knowledge of digital signal controllers with in depth understanding of various on-chip peripherals 2. To impart knowledge of peripheral interfaces and programming of DSC
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Illustrate the need for DSC in power and control applications 2. Describe the architectural features and details of DSC 3. Design the DSC analog interface for real world measurements 4. Use the DSC digital interface for power and control applications 5. Compare and recommend the use of on-chip communication for various applications

Module	**Details**	**Hours**
1	**Introduction** Review of microprocessor, microcontroller and digital signal processors (DSP) architecture, Fixed and floating-point processors Number formats and operations: Fixed point 16 bit numbers representations of signed integers and fraction, Floating Point Numbers. Review of commonly used DSP processors and their applications, introduction to TMS320C2000 digital signal controller (DSC)	06
2	**DSC Architecture** Overview of TMS320C2000 Digital signal controller family – Features, Architecture, Interrupt and Reset, Memory map - On-chip memories: Flash, RAM, and Boot ROM, Clock system	06
3	**DSC Programming** Code development process, Assembly language programming, Linker, C Compiler, Code Composer Studio (CCS) and online debugging tools	05
4	**Analog Interface for DSC** Analog to Digital Converter (ADC): operating principal block diagram, modes of operation, configuration of ADC sensing voltage, current and other analog signal, programming for analog interface. Design aspects for real world measurements.	07
5	**Digital Interface for DSC:** Block diagram, operation and configuration details of-Digital I/O -CPU Timers –Pulse Width Modulator (PWM), High Resolution PWM, Capture Module, Quadrature Encoder Pulse (QEP); use of these peripherals for real time power and control applications	08
6	**DSC Communication Interface and Protocols:** On chip communication interface, configuration and use- Controller Area Network, SPI/SCI, I2C. Physical layer interface, programming for data transfer.	07

Reference Books:

1. Digital Signal Processing in Power Electronics Control Circuits by Krzysztof Sozanski, Springer

2. Digital Signal Processing in Power System Protection and Control by Waldemar Rebizant, Janusz Szafran, and Andrzej Wiszniewski, Springer.
3. Digital Power Electronics and Applications by *Fang Lin Luo, Hong Ye and Muhammad Rashid,* Elsevier Academic Press.
4. Digital Signal Processing in Power Electronics Control Circuits by Krzysztof Sozanski, Springer
5. DSP Based Electromechanical Motion Control by Hamid Toliyat and Steven Campbell, CRC Press

Web References:

1. https://training.ti.com/c2000-f2837xd-microcontroller-one-day-workshop-series
2. https://software-dl.ti.com/trainingTTO/trainingTTO_public_sw/c28x28379/F2837xD_Microcontroller_M
3. https://www.ti.com/microcontrollers-mcus-processors/microcontrollers/c2000-real-time-control-mcus/overview.html
4. The Essential Guide for Developing with C2000™RealTime Microcontrollers: Texas Instruments

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE1021	**Microgrid Technology**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE1021	**Microgrid Technology**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. To introduce the fundamental concept, various power architectures and control of distributed generation and microgrids. 2. To review various regulatory standards and state of the art of microgrids 3. To understand the microgrid and Smart Grid deployments for large scale integration of clean energy sources, various technologies, automation and ICT infrastructure requirements.
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. To identify and describe the impact of renewable energy integration for mitigating energy crises and sustainable future. 2. To identify and describe the concept of Microgrid and its various topologies, modes of operation control and communication architecture. 3. Illustrate various control architectures of Microgrids 4. To identify and describe the concept of Smart Grid, its features and the state of the art. 5. To understand various Smart Grid technologies, automation, resiliency and its adoption in current power system.

Module	**Details**	**Hours**
1	**Power System Scenario:** Present Energy Scenario, Review of various renewable technologies: Impact of grid integration of renewable energy resources on existing power system, Energy storage system and their role in enhancement of performance.	05
2	**Introduction to Microgrid:** Concept of distributed generation, regulatory standard IEEE 1547, requirement for grid interconnection, islanding issue; Concept of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids.	05
3	**Power Electronics interfaces in Microgrids:** PE interfaces in DC and AC microgrids, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, Control architecture: centralized control, decentralized / distributed control , hierarchical control, Multi agent System (MAS) based control	08
4	**Islanding and protection Microgrids:** protection issues, fault current source (FCS), adaptive protection scheme; islanding, anti-islanding schemes, active and passive anti-islanding schemes	06
5	**Design of Microgrids:** Selection and sizing of sources, PE interface design considerations, System level control implementation, Energy Management considerations	07

6	**Introduction to Smart Grid:** Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid; *Smart Grid Technologies:* Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR).; *Communication Technology for Microgrids & Smart Grid:* Review of Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN), ZigBee, Mesh Network; Cyber Security for Smart Grid.	08

Text Books :

1. Microgrids architectures and control Edited by Nikos Hatziargyriou, Wiley, IEEE Press, 2014
2. A. Keyhani, M. N. Marwali, M. Dai, Integration of Green and Renewable Energy in Electric Power Systems, Wiley, 2009
3. Antonio Carlos Zambroni de Souza, Miguel Castilla, Microgrids Design and Implementation, Springer 2019.

Reference Books:

1. A. Yezdani, and Reza Iravani, Voltage *Source Converters in Power Systems: Modeling, Control and Applications*, John Wiley Publications, 2010
2. Dorin Neacsu, *Power Switching Converters: Medium and High Power*, CRC Press, 2006
3. B. M. Buchholz and Z. Styczynski, *Smart Grids – Fundamentals and Technologies in Electricity Networks,* Springer, 2014
4. C. W. Gellings, *The Smart Grid: Enabling Energy Efficiency and Demand Response*, CRC Press, 2009
5. J. Ekanayake, N. Jenkins, K. Liyanage, J. Wu, A. Yokoyama, *Smart Grid: Technology and Applications*, Wiley, 2012
6. J. C. Sabonnadière and N. Hadjsaïd, *Smart Grids*, John Wiley & Sons and ISTE, 2012
7. IEEE standards —IEEE-1547-2003: IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems IEEE standards 2003
8. IEEE standards —IEEE 1547-4-2011: IEEE Guide for Design Operation & Integration of Distributed Resources Island System with Electric Power System,
9. Consortium for Electric Reliability Technology Solutions (CERTS) white paper on Integration of Distributed Energy Resources: The CERTS Microgrid Concept‘ 2002

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE1021	**IoT Applications in Electrical Engineering**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE1021	**IoT Applications in Electrical Engineering**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. To learn the concepts of IOT. 2. To identify the different IoT technology. 3. To learn different protocols used in IOT. 4. To learn how to analyse the data in IOT. 5. To learn different applications in IOT
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Apply the concepts of IOT. 2. Identify the different technology. 3. Analysis and evaluate protocols used in IOT 4. Analysis and evaluate the data received through sensors in IOT. 5. Apply IOT to different applications.

Module	**Details**	**Hours**
1	**Introduction to Internet of Things**: Definition and characteristics of IoT, Physical design of IoT- Things in IoT, IoT protocol, Logical design of IoT – IoT functional blocks, IoT Communication Models, IoT communication APIs.	04
2	**Various Technologies for Implementations of IOT:** Defining Specifications About - Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration, Application Development, Case Study	06
3	**Communication Technologies:** Introduction to Communication Technologies 802.15.4, ZigBee, BLE, WiFi, LORA, GSM basic protocol, topologies, data rate, range, power, computations/bandwidth, QoS	06
4	**Communication Model and Protocols:** Communication Model and Protocols M2M vs IOT, Resource Management, Registration, Discovery Data Exchange Formats – XML & JSON, MQTT Protocol, RESTFul Architecture, HTTP REST Model , CoAP Protocol.	08
5	**RFID Technology:** Introduction, principle of RFID, components of RFID system: RFID tag, Reader, RFID middleware, issues, RFID, transponder, RFID architecture,	09
6	**IOT Application**: Case Studies of IOT Home (Smart Lighting and Intrusion detection), Cities (Smart Parking, Garbage collection), Environment (Pollution detection, Forest Fire Detection), Power (Smart Grid), Retail (Inventory Management), Health (Monitoring and detection)	06

Text Books:

1. Francis DaCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, Apress Publications, 2013
2. Wimer Hazenberg, Menno Huisman and Sara Cordoba Rubino, Meta Products: Building the Internet of Things, BIS publishers.
3. Internet of Things connecting objects to the web, by Hakima Chaouchi, Wiley.
4. Internet of Things (A Hands-on-Approach) by Arshdeep Bhaga and Vijay Madisetti.

Reference Books:

1. The Internet of Things (MIT Press) by Samuel Greengard.
2. The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications).
3. RFID and the Internet of Things, by Herve chabanne, Wiley

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDL101	**Drives and Control Lab**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		--	**2**	**--**	**1**	**1**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDL101	**Drives and Control Lab**	--	--	--	--	--	**25**	**25**	**50**

Course Objectives	To impart knowledge on electrical drives and control
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Simulate drives and control applications. 2. Analyze the simulation results. 3. Identify the implementation methods of drives 4. Interface PLC with Drives for Automation

List of suggested experiments:

1. Develop the model of DC Motor and analyze the performance (Simulation)
2. Develop the model of three phase Induction Motor and analyze the performance (Simulation)
3. Simulation of Half Controlled and Fully Controlled Converter fed DC Drives.
4. Four Quadrant Chopper fed DC Motor.
5. Simulation of PWM Inverter fed Three Phase Induction Motor Control: Compare stator voltage control and V/f control for a constant torque load.
6. Open loop V/f control of Three Phase Induction Motor.
7. Closed loop V/f control of Three Phase Induction Motor.
8. Vector Control of Three Phase Induction Motor.
9. Simulation of Sensorless Control of Three Phase Induction Motor.
10. Speed Control of BLDC Motor.
11. Speed Control of Permanent Magnet Synchronous Motor.
12. Electrical Braking of AC/DC Motor.
13. PLC with AC Drive for Automation - Control using digital / analog / Fieldbus Communication
14. PLC with AC Servo Drive for Position Control.

Reference Books:-

1. Analysis of Electric Machinery P.C. Krause, McGraw Hill, New York
2. Power Semiconductor Controlled Drives, G. K. Dubey, Prentice-Hall International.
3. D. W. Novotny and T. A. Lipo, Vector Control and Dynamics of AC Drives, Oxford University Press, 1996.
4. Power Electronics by Muhammad H. Rashid, Pearson
5. Control of Electrical drives, W. Leonhard, Springer-Verlag.
6. John Chiasson, Modelling and High Performance Control of Electric Machines, Wiley- IEEE Press, 2005.
7. I. Boldea, S. A. Nasar, Vector Control of AC Drives, CRC Press, 1992.

Term work:

Term work shall consist of **minimum eight experiments**.

Experiments Performance : 10 marks
Journal : 10 marks
Attendance : 05 marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

Oral Examination:

Oral examination will be based on entire lab work

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDSBL101	**Power Electronics Design Lab-I**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		--	**4$**	**--**	**2**	**2**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDSBL101	**Power Electronics Design Lab-I**	--	--	--	--	--	**50**	**50**	**100**

Course Objectives	To impart knowledge on 1. Various auxiliary circuits required for power electronic converters 2. Hardware implementation aspects of converters
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Design and implement auxiliary circuits of power electronic converters 2. Design and implement power electronic converters 3. Use controllers for power converter control

List of suggested experiments:

1. Design of Gate driver circuits for Si devices like Power MOSFETS or IGBTs and its PCB fabrication.
2. Design of Gate driver circuits for Wide band gap devices like SiC or GaN and its PCB fabrication.
3. Design and Implementation of Snubber circuit and Heat sink
4. Design of PWM Controller IC based Closed loop controlled DC-DC Converter
5. Design/ Coding of microcontroller based voltage control of DC-DC Converter and its implementation
6. Design/ Coding of microcontroller based voltage control of Inverter and its implementation

Any other design exercise based on Power converters specific to applications in various domains and their implementation.

References:

1. Mohan Ned *et al.*, "Power Electronics Converters, Applications and Design", Wiley India Pvt. Ltd., New Delhi.
2. L. Umanand, Bhatt, "Design of Magnetic Components for Switched Mode Power Converters", John Wiley & Sons
3. NPTEL course on "Design of Power Electronic Converters", Prof. Shabari Nath, IIT Guwahati.
4. NPTEL course on "Advanced Power Electronics and Control", Prof. Avik Bhattacharya, IIT Roorkee.

Term work:

Term work shall consist of **minimum three experiments**.

Experiments Performance : 10 marks
Attendance : 05 marks
Journal : 10 marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

Oral Examination:

Oral examination will be based on entire lab work

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1011	**Product Life Cycle Management**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1011	**Product Life Cycle Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1.To familiarize the students with the need, benefits and components of PLM 2.To acquaint students with Product Data Management & PLM strategies 3. To give insights into new product development program and guidelines for designing and developing a product 4. To familiarize the students with Virtual Product Development
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation. 2. Illustrate various approaches and techniques for designing and developing products. 3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc. 4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	**Contents**	**Hours**
1	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM	10
2	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09

3	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
4	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
5	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
6	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

References:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Assessment:

Internal Assessment for 20 marks: Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1012	**Reliability Engineering**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1012	**Reliability Engineering**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To familiarize the students with various aspects of probability theory 2. To acquaint the students with reliability and its concepts 3. To introduce the students to methods of estimating the system reliability of simple and complex systems 4. To understand the various aspects of Maintainability, Availability and FMEA procedure
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Understand and apply the concept of Probability to engineering problems 2. Apply various reliability concepts to calculate different reliability parameters 3. Estimate the system reliability of simple and complex systems 4. Carry out a Failure Mode Effect and Criticality Analysis

Module	**Detailed Contents**	**Hours**
1	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
2	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
3	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
4	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08

5	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
6	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

References:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1013	**Management Information System**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1013	**Management Information System**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. The course is blend of Management and Technical field. 2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built 3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage 4. Identify the basic steps in systems development
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Explain how information systems Transform Business 2. Identify the impact information systems have on an organization 3. Describe IT infrastructure and its components and its current trends 4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making 5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	**Contents**	**Hours**
1	**Introduction To Information Systems (IS):** Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	04
2	**Data and Knowledge Management:** Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management **Business intelligence (BI):** Managers and Decision Making, BI for Data analysis and Presenting Results	07
3	**Ethical issues and Privacy:** Information Security. Threat to IS, and Security Controls	07
4	**Social Computing (SC):** Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	07
5	**Computer Networks** Wired and Wireless technology, Pervasive computing, Cloud computing model.	06
6	**Information System within Organization:** Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	08

References:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1014	**Design of Experiments**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1014	**Design of Experiments**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To understand the issues and principles of Design of Experiments (DOE) 2. To list the guidelines for designing experiments 3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action 2. Apply the methods taught to real life situations 3. Plan, analyze, and interpret the results of experiments

Module	Contents	Hours
1	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
2	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
3	**Two-Level Factorial Designs** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07

4	**Two-Level Fractional Factorial Designs** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
5	**Response Surface Methods and Designs** 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07
6	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Practical Experiment Designs for Engineers and Scientists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T. Voss

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1015	**Operations Research**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1015	**Operations Research**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. Formulate a real-world problem as a mathematical programming model. 2. Understand the mathematical tools that are needed to solve optimization problems. 3. Use mathematical software to solve the proposed models.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness. 2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change. 3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems. 4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	**Contents**	**Hours**
1	**Introduction to Operations Research**: Introduction, Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14

2	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
3	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
4	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
5	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
6	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model	05

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1016	**Cyber Security and Laws**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1016	**Cyber Security and Laws**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To understand and identify different types cybercrime and cyber law 2. To recognized Indian IT Act 2008 and its latest amendments 3. To learn various types of security standards compliances
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Understand the concept of cybercrime and its effect on outside world 2. Interpret and apply IT law in various legal issues 3. Distinguish different aspects of cyber law 4. Apply Information Security Standards compliance during software design and development

Module	**Contents**	**Hours**
1	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
2	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
3	**Tools and Methods Used in Cyberline:** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
4	**The Concept of Cyberspace**: E-Commerce, The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8

5	**Indian IT Act:** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
6	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

References:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes by Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security* &*Global Information Assurance* Information Science Publishing.
7. William Stallings*, Cryptography and Network Security,* Pearson Publication
8. Websites for more information is available on: The Information Technology ACT, 2008- TIFR: https://www.tifrh.res.in
9. Website for more information: A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primerprofessionals-33538

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1017	**Disaster Management and Mitigation Measures**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1017	**Disaster Management and Mitigation Measures**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To understand physics and various types of disaster occurring around the world 2. To identify extent and damaging capacity of a disaster 3. To study and understand the means of losses and methods to overcome /minimize it. 4. To understand role of individual and various organization during and after disaster 5. To understand application of GIS in the field of disaster management 6. To understand the emergency government response structures before, during and after disaster
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Get to know natural as well as manmade disaster and their extent and possible effects on the economy. 2 Plan of national importance structures based upon the previous history. 3 Get acquainted with government policies, acts and various organizational structure associated with an emergency. 4 Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	**Contents**	**Hours**
1	**Introduction** 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
2	**Natural Disaster and Manmade disasters:** 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
3	**Disaster Management, Policy and Administration** 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and coordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06

4	**Institutional Framework for Disaster Management in India:** 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
5	**Financing Relief Measures:** 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
6	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

References:

1. 'Disaster Management' by Harsh K. Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S. Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Assessment:

Internal Assessment for 20 marks: Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1018	**Energy Audit and Management**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1018	**Energy Audit and Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation. 2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management 3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. To identify and describe present state of energy security and its importance. 2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility. 3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities. 4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities 5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	**Contents**	**Hours**
1	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
2	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
3	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers.	10

	Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
4	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
5	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
6	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

5.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-I						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE1019	**Development Engineering**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE1019	**Development Engineering**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development 2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas 3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals 4. To understand the Nature and Type of Human Values relevant to Planning Institutions
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Apply knowledge for Rural Development. 2. Apply knowledge for Management Issues. 3. Apply knowledge for Initiatives and Strategies 4. Develop acumen for higher education and research. 5. Master the art of working in group of different nature. 6. Develop confidence to take up rural project activities independently

Module	**Contents**	**Hours**
1	**Introduction to Rural Development:** Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	**Post-Independence Rural Development:** Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	04
3	**Rural Development Initiatives in Five Year Plans:** Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	06

4	**Post 73rd Amendment Scenario:** 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	10
6	**Ethics:** Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

References:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V., Conflicting Rationalities: -Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved Semester VIII Institute Level Optional Courses**

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDC201	**Advanced Power Electronics**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDC201	**Advanced Power Electronics**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	**To impart knowledge on** 1. Dc to dc conversion with isolation, the underlying principles of converter operation and hence to analyze different converter circuits for power conversion. 2. Design of magnetics such as high frequency transformers and inductors. 3. Modeling of converter and design the controller for deeper understanding and detailed analysis. 4. Latest technologies and research going on in different areas related to power electronics.
Course Outcomes	**Upon successful completion of this course, the learner will be able to** 1. Select and design magnetics and power electronic converters for a broad range of energy conversion applications. 2. Model and design controllers for the closed loop operation of power converters. 3. Apply the basic concepts of power electronics to design the circuits in the fields of AC and DC drives, power generation and transmission and energy conversion, industrial applications, extraction of energy from renewable sources. 4. Deliver technological solution in the field of power electronics.

Module	**Details**	**Hours**
1	**Isolated dc to dc converters** Advantages of switching power supplies, unidirectional and bidirectional core excitation, fly back, forward, push-pull and bridge converters, Selection of converters for various applications, numericals.	08
2	**Design of DC-DC converters:** Selection of diode, controllable devices and capacitor of Buck, Boost, Buck-Boost converters and Flyback converters for various applications. Design of Magnetics: Area product approach, design of high frequency inductor, design of high frequency transformer, numericals (No derivation in qu paper).	05
3	**Control Methods** PWM duty ratio control, Voltage feed forward PWM control, current mode control, slope compensation, comparison of current mode and voltage mode control.	04
4	**Modelling and Compensator design** State space model of various ideal and non-ideal Buck, Boost and Buck-Boost and Flyback dc to dc converters, state space averaging techniques, small signal analysis, transfer function, feedback control, compensator design, State space model of VSI and compensator design.	10
5	**Multi-Level Inverter:**	05

	Need for multilevel inverters, Diode clamped, flying capacitor and cascaded MLI, Phase shifted and level shifted PWM techniques, Applications of multilevel inverters.	
6	**Applications of power electronic converters** Comparison of hard switching and soft switching, ZVS & ZCS resonant converters in high frequency applications, Converters for extracting power from renewable sources like solar and wind, Converters for Uninterrupted power supplies.	04

Text Books:

1. N. Mohan, T. M. Undeland, W.P Robbins, —Power Electronics, Converters, Applications & Design, Wiley India Pvt. Ltd.
2. M. H. Rashid, —Hand book of Power Electronics", Academic Press,2001.
3. Daniel Hart, "Power Electronics", McGraw Hill Publications 2010.
4. Joseph Vithayathil, —Power Electronics, Tata McGraw Hill.
5. P.S Bhimbra, "Power Electronics", Khanna Publishers.
6. Simon Ang, Alejandro Oliva, "Power-Switching Converters" Taylor and Francis group
7. R W Erickson and D Maksimovic, Fundamental of Power Electronics‖ Springer, 2nd Edition.

Other References/Journals

1. P. T. Krein, Elements of Power Electronics‖, Oxford University Press.
2. L. Umanad, Power Electronics: Essentials & Applications, Wiley.
3. IEEE Transaction journals, IECON, APEC and other power electronic related Conference Proceedings etc.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDC202	**Digital Control of Electrical Drives**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDC202	**Digital Control of Electrical Drives**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	To impart knowledge on digital control of electrical drive
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Design digital control scheme of DC-DC Converter 2. Design digital scalar control scheme of three phase induction motor 3. Design digital vector control scheme of three phase induction motor 4. Design digital control scheme of BLDC Motor

Module	**Details**	**Hours**
1	**Modelling and Analysis of Electrical Drive Components:** Block diagram of DC drive, State space model of DC-DC converter (Buck/Boost), Small signal analysis of DC-DC converters. Modelling of DC Motors (Shunt motor). Block diagram of AC drive. Commonly used reference frames (d-q Stationary reference frame and synchronously rotating reference frame. State space Model of AC Motor (Induction motor), Large Signal Modelling of Inverter. Digital Data Acquisition system, Voltage Sensors, Current Sensors, Frequency Sensors and Speed Sensors.	07
2	**Digital control design:** Practical Aspects of the Choice of Sampling Rate, Principles of Discretization, Digital controller with Bilinear Transformation, Inverse Z Transform to Derive Discrete Domain Equations, Frequency Response and Warping, Digital PID controller. Digital filter implementation. Anti-Wind Up Loop Implementation, ADC Delay Consideration. Selection of DSP according to the Requirement.	06
3	**Digital Control of DC-DC Converter:** Open Loop Control of Buck/Boost Converter, Selection of Power switches. Current, Voltage and Dual Loop Closed Loop Digital Control of DC-DC Converter, Digital Control Loop Sampling Scheme, DC-DC Controller Design, Digital implementation of complete system.	06
4	**Speed Controller:** Basic Structure of the Speed-Controlled System, Open-loop and closed-loop Transfer Functions, Load Rejection of the Proportional Speed Controller, Proportional Speed Controller with Variable Reference, Proportional Speed Controller with Frictional Load, The Speed Controller with Proportional and Integral action, Transfer Functions of the system with a PI controller, Parameter Setting and the closed-loop Bandwidth, Discrete-time Implementation of Speed Controllers, Analysis of the system with a PI Discrete-time Speed Controller.	06

5	**Digital control of three phase Induction motor**: Open loop Speed Control Implementation of Induction Motor using Sine PWM and Space Vector PWM controller or Third Harmonic Insertion technique, Speed Estimation Algorithm Using Encoder Signal, Closed Loop Scalar Control Implementation, Flux Estimation Algorithm, Indirect Vector Control Algorithm, Sine And Cosine Resolver for Direct Vector Control, Direct Vector Control Algorithm, Direct Torque Control Algorithm Implementation.	08
6	**Digital Control of BLDC Motor, PMSM and Switched Reluctance Motor:** Hall based Sensors, Look up Table Formation based on Hall Sensors Output, DSP Implementation: Speed and Torque Control using Voltage and Current Control Algorithms, Sensorless Control of BLDC Motor Drive, V/f Control of PMSM Motor, Vector control of PMSM Motor, Current Control of SRM with the help of Position Sensors, Digital ICs used for different types of motor control	06

Text Books:-

1. Digital Control of Electrical Drives (Power Electronics and Power Systems) by Slobodan N. Vukosavic, Springer.
2. M. B. Patil, M. C. Chandorkar, V. Ramanarayanan, V. T. Ranganathan, Simulation of Power Electronic Circuits. Narosa Series in Power and Energy System, 2009.
3. Modern Power Electronics and AC Drives by B. K. Bose, Prentice Hall PTR
4. Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB / Simulink, Ned Mohan, Wiley, 2014.

References:-

1. Industrial Motion Control: Motor Selection, Drives, Controller Tuning, Applications, Hakan Gurocak, Wiley, 2016.
2. Electric Motor Drives: Modeling, Analysis and Control by Krishnan.R, PHI.
3. From Continuous-Times Domain to Microcontroller Code By Jonathan Dodge, P.E.
4. Designing a TMS320F280x Based Digitally Controlled DC-DC Switching Power Supply by Texas Instruments
5. Sensorless Field Oriented Control of 3-Phase Induction Motors Using F2833x by TI
6. Scalar (V/f) Control of 3-Phase Induction Motors by TI
7. BLDC Motor Control with Hall Sensors based on FRDM-KE02Z.

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE2011	**Power Electronics in Power System**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE2011	**Power Electronics in Power System**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To know the basic principle of conventional active and reactive power flow control in power systems and problems associated with long distance power transmission. 2. To make students aware how power electronics devices can be used to find solution to the problems in long distance power transmission
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Select and implement proper compensator to solve the problems occurring in long distance power transmission 2. Illustrate the operational details of Series and Shunt compensators 3. Describe the objectives of load compensation 4. State the basic operating principal of UPFC

Module	Contents	Hours
1	**Introduction:** Steady state and dynamic problems in AC systems- Transmission interconnections- Flow of power in an AC system- Loading capability- Power flow and dynamic stability considerations of a transmission interconnection. Relative importance of controllable parameters. Basic types of FACTS controllers.	08
2	**Static shunt compensators:** Objectives of shunt compensation, Methods of controllable Var generation. Variable impedance type static Var generators (TCR, TSR, TSC,FC-TCR), Switching converter type Var generators.	08
3	**Static series compensation:** Objectives of series compensation- Variable impedance type series compensation- TSSC and TCSC. Switching converter type series compensators – SSSC.	06
4	**Static voltage and phase angle regulators:** Objectives of voltage and phase angle regulators, Approaches to TCVR and TCPAR, switching converter based voltage and phase angle regulators.	06
5	**Load Compensation:** Objectives of load compensation. Compensating single phase loads using DSTATCOM, Ideal three phase shunt compensator structure, Series compensation of power distribution system using DVR.	06
6	**Unified Power Flow Controller (UPFC):** Basic operating principle, Conventional transmission control capabilities	05

Text Books:

1. Hingorani N.G. & Gyugi L., Understanding FACTS :Concepts and Technology of Flexible AC Transmission Systems,‖ Wiley-IEEE Press
2. Timothy J. E. Miller, Reactive power control in Electric Systems, Wiley India Edition.

Reference Books:

1. Yong Hua Song —Flexible AC Transmission System, Institution of Electrical Engineers, London
2. Arindam Ghosh and Gerard Ledwich, — Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE2012	**Industrial Load Modelling and Control**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE2012	**Industrial Load Modelling and Control**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. To understand the energy demand scenario 2. To understand the modelling of load and its ease to study load demand industrially 3. To know Electricity pricing models 4. 4. Study Reactive power management in Industries
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Understand the role of Industrial load Management in present electrical energy scenario 2. Understand different load control techniques in industries and its application. 3. Understand reactive power management and its controls. 4. Understand various cooling and heating loads its control strategies 5. Understand captive power management and its control strategies 6. Understand and apply different optimal operation strategies to reduce demand of electricity during peak time.

Module	**Details**	**Hours**
1	**Introduction:** Electric Energy Scenario-Demand Side Management-Industrial Load Management. Load Curves-Load Shaping Objectives-Methodologies. Barriers; Classification of Industrial Loads- Continuous and Batch processes -Load Modelling, Electricity pricing – Dynamic and spot pricing –Models.	08
2	**Load Control Methods:** Direct load control- Interruptible load control. Bottom up approach- scheduling- Formulation of load models- Optimization and control algorithms - Case studies.	07
3	**Reactive Power Management** Reactive power management in industries-controls-power quality impacts application of filters Energy saving in industries.	06
4	**Cooling and Heating Loads:** Load profiling- Modelling. Cold storage-Types- Control strategies. Optimal operation- Problem formulation- Case studies.	06
5	**Captive Power Management:** Captive power units- Operating and control strategies- Power Pooling- Operation models. Energy banking-Industrial Cogeneration	06
6	**Optimal Operation Strategies:** Selection of Schemes Optimal Operating Strategies. Peak load shaving-Constraints- Problem formulation- Case study. Integrated Load management for Industries	06

Books Recommended:

1. C.O. Bjork “Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands, 1989.
2. C.W. Gellings and S.N. Talukdar, “Load management concepts,” IEEE Press, New York, 1986, pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981.
4. H. G. Stoll, "Least cost Electricity Utility Planning”, Wiley Interscience Publication, USA, 1989.
5. I. J. Nagarath and D. P. Kothari, Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.
6. IEEE Bronze Book- “Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities”, IEEE Inc, USA.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE2013	**DSP Applications in Power Conversion Systems**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE2013	**DSP Applications in Power Conversion Systems**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	**To impart knowledge on** 1. Real time applications using DSP processors 2. Interfacing of DSP with various power converters 3. Programming DSP for Power and control applications
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Use mathematical tools for DSP applications in real time power and control applications 2. Program the DSP for various building blocks of real time power and control applications 3. Design and implement DSP based control of power Electronic converters 4. Model and analyze the closed loop power Electronic system 5. Illustrate the use of DSP in various industrial applications

Module	Details	Hours
1	**Introduction:** DSP/DSC for real time power and control applications, requirements, analog and digital interfaces. Review of mathematical tools for DSP applications: numerical integration: Euler's implicit and explicit method, Heun's Method, Trapezoidal Method; Implementation of digital filters and transformations, PLL, Harmonic oscillator, Harmonic extraction.	08
2	**DSP based DC-DC Converter Control:** Buck converter, Boost converter and Bidirectional Converter: closed loop control implementation: hardware and control program for current, voltage and power control. Control implementation with PI, Type II and Type III controller	08
3	**DSP based DC-AC Converter Control:** Standalone and Grid tied inverter (single and three phase) : closed loop control implementation: hardware and control program for current, voltage and power control.	08
4	**DSP based AC-DC Converter Control:** Active Front End (AFE) converter : closed loop control implementation: hardware and control programing	07
5	**DSP based multi-converter system:** Multi-stage converter system control with DSP, requirement of analog / digital and communication interfaces	04
6	**DSP applications in Industrial Domains:** Overview of DSP applications in Traction converters, Electric Vehicles, UPS systems	04

Reference Books:

1. Digital Signal Processing in Power Electronics Control Circuits by Krzysztof Sozanski, Springer
2. Digital Signal Processing in Power System Protection and Control by Waldemar Rebizant, Janusz Szafran, and Andrzej Wiszniewski, Springer.
3. Digital Power Electronics and Applications by *Fang Lin Luo, Hong Ye and Muhammad Rashid,* Elsevier Academic Press.
4. Digital Signal Processing in Power Electronics Control Circuits by Krzysztof Sozanski, Springer
5. DSP Based Electromechanical Motion Control by Hamid Toliyat and Steven Campbell, CRC Press

Web References:

1. https://training.ti.com/c2000-f2837xd-microcontroller-one-day-workshop-series
2. https://software-dl.ti.com/trainingTTO/trainingTTO_public_sw/c28x28379/F2837xD_Microcontroller_M
3. https://www.ti.com/microcontrollers-mcus-processors/microcontrollers/c2000-real-time-control-mcus/overview.html
4. The Essential Guide for Developing with C2000™RealTime Microcontrollers: Texas Instruments

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE2021	**Design of Electric Vehicles Systems**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract /Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE2021	**Design of Electric Vehicles Systems**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. To illustrate the design philosophies used in the EV domain. 2. To explore the selection of power and control architecture of EV drives 3. To study the design aspects of EV battery packs and other auxiliary systems
Course Outcomes	**Upon successful completion of this course, the learner will be able:** 1. To select and size the electric motor for a particular EV application and performance criteria 2. To select and size the battery pack to meet desired EV performance and 3. To design the EV drive system with functional safety considerations. 4. To illustrate the use of hybrid energy source for EV performance improvement 5. To illustrate the design aspects of Automotive Subsystem 6. To design the EV chargers and charging infrastructure

Module	**Details**	**Hours**
1	**<u>Selection and Sizing of EV Motors:</u>** Electric Vehicle modelling, Tractive force calculations, Design considerations for 2W, 3W and 4W EVs; Torque, power and Speed requirement, Vehicle Power Demand Vehicle Performance Envelope, and Vehicle Power Envelope; Vehicle Power Demand during Driving Cycles. Design considerations for EV motors and their cooling system.	06
2	**Selection and Sizing of On-board Energy Resource:** Selection of type of Battery pack for 2W, 3W and 4W EVs; Battery pack sizing: Design considerations: Range per charge, range anxiety, EV motor power requirement; High-Voltage Cabling and Disconnects, Safety in Battery Design, Testing for safety. Selection and sizing of Fuel cell for FCEV, design considerations; Battery-ultra-capacitor hybrid combination sizing, performance analysis.	08
3	**Automotive Subsystem Design:** Electronic Control Unit (ECU) and its Control Features, Communications between ECUs, Control Software Development: Software-in-the-Loop (SIL) Simulation and Hardware-in-the-Loop (HIL) Simulation. Acceleration and braking control, regenerative braking; Design considerations of HVAC controller	05
4	**EV System Integration:** EMC design on ECU level, EMC design on system level and in special subsystems, Radiated emissions and Conducted emissions, EMI EMC measurements.	04
5	**Design of Charging Infrastructure:** Design considerations for AC charger: vehicle interface and charging protocol design. applicable charging standards.	08

	Design of On-Board Charger (OBC)-Schematic, power topology and control, Power capacities, regenerative braking control. Design considerations of DC fast charger: vehicle interface and charging protocol design. Connectivity and applicable charging standards Installation guidelines and grid requirement for charger installations.	
6	**Design with Functional Safety:** Functional Safety requirements of Automotive Electronics; ASIL identification and safety goal finalization, ISO 26262. Energy Storage integrity / protection: rupture and toxic gas management; Unintended vehicle movement, shock protection.	08

Text/Reference Books:-

1. Design and Control of Automotive Propulsion Systems by Zongxuan Sun and Guoming Zhu, CRC Press, 2015
2. Electric Vehicle Machines and Drives Design, Analysis and Application by K. T. Chau, IEEE Press, and Wiley, 2015
3. EMC and Functional Safety of Automotive Electronics by Kai Borgeest, IET, 2018

Website Reference / Video Courses:

1. **NPTEL Web Course:** Electric Vehicles - Part 1 by PROF. AMIT KUMAR JAIN Department of Electrical Engineering IIT Delhi; https://nptel.ac.in/courses/108/102/108102121/
2. **NPTEL Web Course:** Fundamentals of Electric vehicles: Technology & Economics**,** by Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras, https://nptel.ac.in/courses/108/106/108106170/
3. **NPTEL Web Course:** Introduction to Hybrid and Electric Vehicles by Dr. Praveen Kumar and Prof. S. Majhi, IIT Guwahati, https://nptel.ac.in/courses/108/103/108103009/

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE2022	**Design of Power Converters**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDPE2022	**Design of Power Converters**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. To understand and select high power devices, gain knowledge about power modules, suitable packaging and latest market trends. 2. To understand and analyse high power converters and the protection needed for the converters. 3. To keep abreast with the latest technologies and research going on in different areas related to high power converters. 4. To enhance the knowledge of practical aspects in the design of Power Converters. 5. To deliver technological solution in the field of power electronics.
Course Outcomes	**Upon successful completion of this course, the learner will be able to** 1. Analyze and understand high power devices and practical issues in implementing high power converters. 2. Understand protection aspects and design considerations to build proper power electronics systems. 3. Design closed loop control and discretize controllers for using digital control methods. 4. Analyze and design converters in the fields of drives, power generation and energy conversion, industrial applications, extraction of energy from renewable sources.

Module	**Details**	**Hours**
1	**High power switching devices and drivers:** Issues with conventional switches in high power applications, View of power device market trend, series connected devices, voltage equalization techniques-static and dynamic, **i**ntelligent power modules, packages for high power devices, drivers for wide band gap devices.	04
2	**High power converters and Protection:** Review of Multi level inverters, Cascaded H bridge multilevel inverters, Modular Multi level converters. Practical Aspects in building Three-Phase Power Converters- Motor drives, Grid applications. Protection aspects-Over current, Over voltage, temperature, snubber design-component selection, basics of resonant snubber and regenerative snubber, numericals included.	10
3	**Design considerations:** Electrical specifications, Mechanical specifications, Environmental specifications, EMI/EMC specifications, Hardware specifications, Thermal Management **,** Selection of switching frequency, Selection of switching device and topology, cost.	06

4	**Closed-Loop control:** Analog PWM controllers**,** Digital control-advantages**,** Signal conditioning and sampling, digital implementation of PWM modulator-single update and double update mode, PI & PR controller discretization, effect of computational delay, Processors in converter control, Grid synchronization techniques, introduction to non-linear control methods.	08
5	**Design of High power converters for drives:** Requirements and challenges**, s**witching device constraints, converter configurations, control aspects, case studies of design of drive application.	05
6	**Design of Grid interfaced converters:** Requirements and challenges, high power grid interfaced converters, current control, grid synchronization, filter design, dc link voltage control, case studies on grid interfacing of renewable energy sources.	06

Text Books:

1. Dorin O. Neacsu, "Switching Power Converters, Medium and High Power", CRC press, Taylor & Francis group, second edition, 2017.
2. Bin Wu, "High Power Converters and AC drives", IEEE press, John Wiley & Sons.
3. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
4. Simon Ang, Alejandro Oliva, "Power-Switching Converters", Taylor and Francis group.
5. A Yazdani, R. Iravani, "Voltage- Sourced Converters in Power Systems", Wiley, IEEE press.
6. B. Jayant Baliga, "Silicon Carbide Power Devices", World Scientific, 2005.

Reference Books:

1. R. Teodoresco, M. Liserrie,P. Rodr´ıguez "Grid Converters for Photovoltaic and Wind Power Systems", John Wiley and Sons.
2. L. Umanad, "Power Electronics: Essentials & Applications", Wiley.
3. V. Ramanarayanan, "Course Material on Switched Mode Power Conversion", 2007.
4. M. Jamil, M. Rizwan, D.P Kothari, "Grid Integration of Solar Photovoltaic Systems", CRC press, Taylor & Francis.
5. Peter Friedrichs, T. Kimoto, L. Ley and G. Pensl, "Silicon Carbide, Volume 2: Power Devices and Sensors", Wiley Publications, 2011.
6. Relevant Papers published in reputed Journals, Conference/NPTEL lectures.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDPE2023	**Power Converters for Renewable Energy**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**		**3**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg.**					
PEDPE2023	**Power Converters for Renewable Energy**	**20**	**20**	**20**	**80**	**3**	**-**	**-**	**100**

Course Objectives	1. To introduce the distributed generation system based on renewable energy resources. 2. To know the practical aspects of design of power converters for renewable energy sources. 3. To know the control implementation for power converters.
Course Outcomes	**Upon successful completion of this course, the learner will be able:** 1. To illustrate operating principle and characteristics of various RES 2. To identify and describe various topologies of DGs based on use of various combinations of RES. 3. To design the power converters for solar PV applications. 4. To identify and describe the design considerations for the power converters for wind energy systems. 5. To identify and describe the design considerations for the power converters for fuel cell systems. 6. To model and design compensator for power converters operating in voltage and current control mode.

Module	**Details**	**Hours**
1	**Introduction to renewable sources:** Review of renewable energy sources, operating principles and characteristics of: Solar PV, Wind Energy Systems (WES), Fuel cells; Economics and statistics related to renewable energy. Review of energy storage systems with Batteries and ultra-capacitors. Categorization of energy sources	4
2	**Distributed generation system:** Basic concepts, various topologies and design considerations for standalone systems and grid connected systems, Power quality and protection issues, review of regulatory standards related to various aspects of renewable energy systems	4
3	**Design of power converters for Solar PV:** MPPT (maximum power point tracking), Design of DC-DC converters for MPPT, MPPT algorithms, Implementation of MPPT control through DSP controllers. Topologies for grid connected and standalone applications: single phase and three phase systems, Design of multi stage solar PV grid connected and standalone systems. Low and high power Applications. Integration of ES-battery and ultra-capacitor for performance improvement, Converters for PV based charging stations for EV	10
4	**Design of power converters for WES:** Topologies of WES, design considerations for WES with rectifier / inverter system, Power Converters for Doubly Fed Induction Generators (DFIG) in Wind Turbines, Matrix converter topology for grid connected system.	06

5	**Design of power converters for Fuel Cell:** Review of fuel cell technology, Design of DC-DC converters for PEM fuel cell, MPPT in Fuel Cell, Design considerations for multi-stage converter / inverter system for grid connected operations.	06
6	**Design of compensator for voltage and current control modes:** Modelling of the system, derivation of transfer function compensator for voltage and current control modes, design of PI and Type III controller in power conditioning system for renewable energy sources.	06

Text Books:

1. Power Electronics, Converters, Applications & Design‖, N. Mohan, T. M. Undeland, W.P Robbins, Wiley India Pvt. Ltd.
2. Voltage Source Converters in Power Systems: Modeling, Control and Applications, Amirnaser Yezdani, and Reza Iravani, IEEE John Wiley Publications
3. Power Switching Converters: Medium and High Power, Dorin Neacsu, CRC press, Taylor &Francis, 2006
4. M.H. Rashid, —Power Electronics Hand book‖, Academic Press, 2001

References books /websites:

1. DSP Based Electromechanical Motion Control, Hamid Toliyat and Steven Campbell, CRC Press
2. Digital Signal Processors - Architectures, Implementations, and Applications, Sen M. Kuoand Woon-SengGan Prentice Hall
3. Fuel Cell System, Leo J.M.J. Blomen and michael N. Mugerwa, New York, Plenum Press, 1993.
4. Wind Energy Explained, theory design and applications, J.F. Manwell, J.G. McGowan Wiley publication
5. Fuel Cell Systems Explained, James Larminie, Andrew Dicles, Wiley publication
6. Principles of Solar Engineering‖, D. Y. Goswami, F. Kreith and J. F. Kreider, Taylor and Francis, Philadelphia, 2000
7. Biomass Regenerable Energy, D. D. Hall and R. P. Grover, John Wiley, New York, 1987.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDL201	**DSP Applications Lab**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		--	**2**	**--**	**1**	**1**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDL201	**DSP Applications Lab**	--	--	--	--	--	**25**	**25**	**50**

Course Objectives	To impart knowledge on 1. Use of DSP development boards and DSP programming platform 2. Program DSP for the use of various on board peripherals 3. Use of DSP for control of power electronic converters
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Program in DSP for specific applications 2. Integrate DSP processor with external applications 3. Design and implement closed loop control of power electronic converters using DSP

Hardware and Software tools to be used

- Students can use DSP development boards (Texas Instruments C2000 series like TMS320F28069 / TMS320F28335/ TMS 320F28379D or similar with software platform (Code Composer studio) to perform the suggested experiments. Use of training material (videos and lab manuals) available on Texas Instruments website is recommended.
- Use of emulation platforms with DSP target boards facility can also be done to conduct recommended lab experiments

List of suggested experiments:

A. Use of DSP Peripherals: (minimum three)

1. Mathematical calculations using DSP
2. Sine wave generation using DSP
3. Use of Graph utility and real time debugging interface with DSP
4. ADC application with DSP board
5. PWM (single phase and three phase) generation
6. Use of GPIO for status / indications
7. Use of communication protocols
8. Use of QEP / Capture module for Speed measurement

B. DSP for Power Converter Application (minimum Two)

1. DSP based Open loop operation of DC-DC converter
2. DSP based Closed Loop operation of DC-DC converter
3. DSP based Open loop operation of inverter
4. DSP based Closed loop operation of inverter
5. DSP based PWM rectifier

C. DSP based Power Electronic System (minimum one)

1. DSP based Electric drive: Induction motor with V/F control
2. DSP based BLDC motor drive
3. DSP based LED lamp control
4. DSP based data transfer between two systems with communication interface.

Reference Books:

1. Digital Signal Processing in Power Electronics Control Circuits by Krzysztof Sozanski, Springer
2. Digital Signal Processing in Power System Protection and Control by Waldemar Rebizant, Janusz Szafran, and Andrzej Wiszniewski, Springer.
3. Digital Power Electronics and Applications by *Fang Lin Luo, Hong Ye and Muhammad Rashid,* Elsevier Academic Press.
4. Digital Signal Processing in Power Electronics Control Circuits by Krzysztof Sozanski, Springer
5. DSP Based Electromechanical Motion Control by Hamid Toliyat and Steven Campbell, CRC Press

Web References:

1. https://training.ti.com/c2000-f2837xd-microcontroller-one-day-workshop-series
2. https://software-dl.ti.com/trainingTTO/trainingTTO_public_sw/c28x28379/F2837xD_Microcontroller_M
3. https://www.ti.com/microcontrollers-mcus-processors/microcontrollers/c2000-real-time-control-mcus/overview.html
4. The Essential Guide for Developing with C2000™RealTime Microcontrollers: Texas Instruments

Term work:

Term work shall consist of **minimum six experiments.**

Experiments Performance	: 10 marks
Attendance	: 05 marks
Journal	: 10 marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

Oral Examination:

Oral examination will be based on entire lab work

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDSBL201	**Power Electronics Design Lab-II**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		--	2	--	1	1

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDSBL201	**Power Electronics Design Lab-II**	--	--	--	--	--	50	50	100

Course Objectives	**To impart knowledge on** 1. Design of magnetics in high frequency applications 2. Design of closed loop control of power electronic converters
Course Outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Integrate and program DSP for complete Power Electronic System 2. Design magnetic components of power electronic converters 3. Design closed loop control of power electronic converters and implement it.

List of suggested experiments:

1. Generate a DSP code for applications like MPPT / PLL/ SVM/ any other related to PE and Drives and its testing.
2. Inductor design and its fabrication for Buck or Boost or Buck-Boost DC-DC converter (any one converter)
3. Transformer Design and its Fabrication for any isolated DC-DC converter
4. Design and Implementation of closed loop control of Buck or Boost or Buck-Boost DC-DC converter for switched mode power supplies
5. Design and Implementation of any one isolated DC-DC converter in closed loop
6. Design and Implementation of any Power Electronic converter in closed loop

Any other design exercise based on Power converters specific to applications in various domains.

References:

1. Mohan, Ned. et.al, "Power Electronics Converters, Applications and Design", Wiley India Pvt. Ltd., New Delhi.
2. L. Umanand, Bhatt, "Design of Magnetic Components for Switched Mode Power Converters", John Wiley & Sons
3. NPTEL course on "Design of Power Electronic Converters", Prof. Shabari Nath, IIT Guwahati.
4. NPTEL course on "Advanced Power Electronics and Control", Prof. Avik Bhattacharya, IIT Roorkee.

Term work:

Term work shall consist of minimum Two experiments.

Experiments Performance : 10 marks
Attendance : 05 marks
Journal : 10 marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

Oral Examination:

Oral examination will be based on entire lab work.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE2011	**Project Management**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE2011	**Project Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques. 2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Apply selection criteria and select an appropriate project from different options. 2. Write work break down structure for a project and develop a schedule based on it. 3. Identify opportunities and threats to the project and decide an approach to deal with them strategically. 4. Use Earned value technique and determine & predict status of the project. 5. Capture lessons learned during project phases and document them for future reference

Module	**Detailed Contents**	**Hours**
1	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	05
2	**Initiating Projects:** How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	06
3	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface; Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	08

4	**Planning Projects:** Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	06
5	**5.1 Executing Projects:** Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	08
6	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects, Multicultural and virtual projects **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	06

REFERENCES:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9th Edition, Gower Publishing England

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE2012	**Finance Management**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE2012	**Finance Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques. 2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand Indian finance system and corporate finance 2 Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hours
1	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
2	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
3	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09

4	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
5	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE2013	**Entrepreneurship Development and Management**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE2013	**Entrepreneurship Development and Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To acquaint with entrepreneurship and management of business 2 Understand Indian environment for entrepreneurship 3 Idea of EDP, MSME
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand the concept of business plan and ownerships 2 Interpret key regulations and legal aspects of entrepreneurship in India 3 Understand government policies for entrepreneurs

Module	**Detailed Contents**	**Hours**
1	**Overview of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
2	**Business Plans and Importance of Capital to Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship and Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
3	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
4	**Indian Environment for Entrepreneurship:** key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc.	08
5	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08

6	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

References:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE2014	**Human Resource Management**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE2014	**Human Resource Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To introduce the students with basic concepts, techniques and practices of the human resource management 2 To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations 3 To familiarize the students about the latest developments, trends & different aspects of HRM 4 To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand the concepts, aspects, techniques and practices of the human resource management. 2 Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective. 3 Gain knowledge about the latest developments and trends in HRM. 4 Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	**Contents**	**Hours**
1	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues	05
2	**Organizational Behaviour (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour • Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); • Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	07

3	**Organizational Structure & Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	06
4	**Human Resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment – Job Satisfaction, employee morale • Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning Training & Development: Identification of Training Needs, Training Methods	05
5	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	06
6	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM:** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations:** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, 2016, Pearson Publications

Assessment:

Internal Assessment for 20 marks: Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3, then part (b) will, be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE2015	**Professional Ethics and Corporate Social Responsibility (CSR)**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE2015	**Professional Ethics and Corporate Social Responsibility (CSR)**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To understand professional ethics in business 2 To recognized corporate social responsibility
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand rights and duties of business 2 Distinguish different aspects of corporate social responsibility 3 Demonstrate professional ethics 4 Understand legal aspects of corporate social responsibility

Module	**Detailed Contents**	**Hours**
1	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
2	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
3	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
4	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
5	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
6	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE2016	**Research Methodology**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE2016	**Research Methodology**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To understand Research and Research Process 2 To acquaint students with identifying problems for research and develop research strategies 3 To familiarize students with the techniques of data collection, analysis of data and interpretation
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Prepare a preliminary research design for projects in their subject matter areas 2 Accurately collect, analyze and report data 3 Present complex data or situations clearly 4 Review and analyze research findings

Module	**Detailed Contents**	**Hours**
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
02	**Types of Research** **2.1.** Basic Research **2.2.** Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5.** Empirical Research **2.6** Qualitative and Quantitative Approaches	07
03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07

04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f.** Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	08
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	04

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE2017	**IPR and Patenting**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE2017	**IPR and Patenting**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To understand intellectual property rights protection system 2 To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures 3 To get acquaintance with Patent search and patent filing procedure and applications
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 understand Intellectual Property assets 2 assist individuals and organizations in capacity building 3 work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hours
1	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
2	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
3	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
4	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc.), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
5	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08

6	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** IPR: Drafting, Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
PEDIE2018	Digital Business Management	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	--	3	--	3

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
PEDIE2018	Digital Business Management	20	20	20	80	3	--	--	100

Course Objectives	1 To familiarize with digital business concept 2 To acquaint with E-commerce 3 To give insights into E-business and its strategies
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Identify drivers of digital business 2 Illustrate various approaches and techniques for E-business and management 3 Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts, Difference between physical economy and digital economy. **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services), Opportunities and Challenges in Digital Business	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, managing Risks in e –business, Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06

5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-II						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDIE2019	**Environmental Management**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDIE2019	**Environmental Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 Understand and identify environmental issues relevant to India and global concerns 2 Learn concepts of ecology 3 Familiarise environment related legislations
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand the concept of environmental management 2 Understand ecosystem and interdependence, food chain etc. 3 Understand and interpret environment related legislations

Module	**Detailed Contents**	**Hours**
1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	10
2	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
3	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
4	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	10
5	Total Quality Environmental Management, ISO-14000, EMS certification.	05
6	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,**T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005

5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-III						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDMP301	**Major Project: Dissertation -I**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		--	**20**	**--**	**10**	**10**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract/ Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDMP301	**Major Project: Dissertation -I**	--	--	--	--	--	**100**	**--**	**100**

Guidelines for Dissertation-I

Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format. Guidelines for Assessment of Dissertation-I.

Dissertation-I should be assessed based on following points

- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization
- Clarity of objective and scope

Dissertation-I should be assessed through a presentation by a panel of Internal examiners and external examiner appointed by the Head of the Department/Institute of respective Programme.

M.E. Electrical Engineering (Power Electronics and Drives)- Sem-IV						
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**		**Credits Assigned**		
PEDMP401	**Major Project: Dissertation -II**	**Theory**	**Pract./Tut.**	**Theory**	**Pract./Tut.**	**Total**
		--	**32**	**--**	**16**	**16**

Course Code	**Course Name**	**Examination Scheme**							
		Theory					**Term Work**	**Oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
PEDMP401	**Major Project: Dissertation -II**	--	--	--	--	--	**100**	**100**	**200**

Guidelines for Assessment of Dissertation II

Dissertation II should be assessed based on following points:

- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization or current Research / Industrial trends
- Clarity of objective and scope
- Quality of work attempted or learner contribution
- Validation of results
- Quality of Written and Oral Presentation

Students should publish at least one paper based on the work in referred National/ International conference/Journal of repute.

Dissertation II should be assessed by internal and External Examiners appointed by the University of Mumbai.