First Year M. Tech Electrical (Power System)

Syllabus Structure Semester I

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
							Max	Min for Passing	Max	Min for Passing
EPS5011	Research Methodology	2	--	-	2	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40		
EPS5031	Advanced Computer Methods in Power Systems	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5051	Power System Dynamics	4	--	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5071	Power System Deregulation	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
PE I	Program Elective I (List attached)	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5171	Advanced Computer Methods in Power Systems Lab	--	--	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EPS5191	Power System Dynamics Lab	--	--	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EPS5211	Seminar I	--	--	2	2	ISE	--	--	100	50
EPS5231	Research Methodology Lab	--	--	2	1	ISE	--	--	100	50
IEO5231	Proficiency in Technical Communication	--	--	2	1	ISE	--	--	100	50

Total Credits: 24, Total Contact Hours/Week: 28

Implemented From 2015-16

Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

First Year M. Tech Electrical (Power System)

Syllabus Structure Semester II

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
							Max	Min for Passing	Max	Min for Passing
IET522	Advanced Engineering Mathematics	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5041	Digital Protection of Power System	3	-	--	3	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5061	Power System planning and Reliability	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
PE II	Program Elective II (List attached)	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
IE	Institute Elective (List attached)	3	-	--	3	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5181	Digital Protection of Power System Lab	--	--	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EPS5201	Power System Optimization Techniques Lab	--	--	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EPS5221	Seminar II	--	--	2	2	ISE	--	--	100	50
EPS5241	Comprehensive Viva Voce	-	-	-	1	ESE	-	-	100	50

Total Credits: 24, Total Contact Hours/Week: 28

Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414 K.E.S.

Implemented From 2015-16

Second Year M. Tech Electrical (Power System)
Syllabus Structure
Semester III

Course Code	Course	Teaching Scheme				Evaluation Scheme			
		L	T	P	Credits	Scheme	Credits	Practical (Marks %)	
								Max	Min for Passing
EPS6011	Field Training	--	--	--	2	ISE	2	100	50
EPS6051	Dissertation Stage I	--	--	--	4	ISE	4	100	50
EPS6071	Dissertation Stage II	--	--	5*	10	ISE	4	40	50
EPS6091						ESE	6	60	50

Total Credits: 16, Total Contact Hours/Week: 05

Semester IV

Course Code	Course	Teaching Scheme				Evaluation Scheme			
		L	T	P	Credits	Scheme	Credits	Practical (Marks %)	
								Max	Min for Passing
EPS6021	Dissertation Stage III	--	--	--	08	ISE	4	100	50
EPS6041	Dissertation Stage IV	--	--	5*	10	ISE	4	40	50
EPS6061						ESE	6	60	50

Total Credits: 18, Total Contact Hours/Week: 05

Grand Total of Credits: 24+24+16+18 = 82

Second Year M. Tech Electrical (Power System)

Program Elective I

Course Code	Name of Course
EPS5091	Distribution System Planning and Automation
EPS5111	Design and Testing of HV Apparatus
EPS5131	Advanced Controls of Electric Drives

Program Elective II

Course Code	Name of Course
EPS5081	Integrated Resource Planning
EPS5101	Smart Grid Technologies and Applications.
EPS5121	Economic Operation of Power Systems

First Year PG Electrical Power System
EPS5011 Research Methodology

Course syllabus will be covered in 20 lectures of duration 1 hr. ISE will be based on submission of at least 4 reports on various case studies mentioned in syllabus units.

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
2	-	--	2	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

This course is a mandatory course in FY M. Tech program in Semester I The course introduces students to educational research methods. The aim of the course is to offer students the tools to conceptualize their Master's theses in terms of research methodology, data collection, statistical analysis, report writing and publications. The course is designed to provide prospective researchers with a broad introduction to statistical tools with software.

Course Learning Outcomes:

After completion of the course the student is expected to be able to:

1. Describe different types, philosophies, and methods in research.
2. Identify various ways to collect data to define research problems.
3. Apply different statistical methods or mathematical model to obtain solution for research problems.
4. Write research proposals, articles to publish his/her work.
5. Explain ethical issues pertaining to academic research.

EPS5011 Research Methodology

Syllabus

UNIT 1 – Research Methodology and Research Process: **5hr**

Definition of research and characteristics of research; Types of research; Research process: Formulating the Research Problem, Literature Review, Developing the objectives, preparing the Research Design including Sample Design, Collecting the Data, Analysis of Data, Generalization and Interpretation, Preparation of the Report or Presentation of Results

UNIT 2 - Literature Survey: **5hr**

Importance of literature review, types of literature review, selection of the review topic, searching for the literature, analyzing and synthesizing the literature, writing the review report.

UNIT 3 - Statistical Tools for Analysis: **5hr**

Analysis of variance, regression analysis, Response surface methods for process optimization

UNIT 4 - Design and Analysis of Experiments: **9hr**

Strategy of experimentation, Statistical design of experiments, replication, randomization and blocking. Guidelines for designing experiments Factorial designs. The two factor factorial design, Statistical analysis of factorial design Taguchi design Writing a research proposal: Title, Abstract, Introduction, Rationale, Objectives, Methodology, Time frame and work plan, Budget and Justification, References

Reference

1. Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi).
2. Krishnswamy, K.N., Shivkumar, Appa Iyer and Mathiranjan M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
3 Gautam, N. C. (2004) Development of Research tools, New Delhi, Shree Publishers.
4. Gupta, Santosh (2005) Research Methodology and Statistical Techniques, Deep and Deep Publications.
5. Brymann, Alan and Carmer, D. (1995) Qualitative data analysis for social scientist, Newyork, Routledge Publication.
6. Douglas C. Montgomery, Desig and analysis of experiments, John Willey and Sons, New York.
7. Tapan Bagchi, Taguchi Methods Explained: Practical steps to robust design, Prentice Hall

First Year PG Electrical Power System
EPS5031 Advanced Computer Methods in Power Systems

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	1	--	4	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

This course is a core course in F.Y. M. Tech program in Semester I. The main goal of the course is to quickly review and then advance the student's existing knowledge of power system analysis. Emphasis is on foundation theories, advanced analysis methods, developing conceptual insights, and gaining experience with applicable software simulation and analysis packages. The course will then cover the topics of transmission line parameter calculation, symmetrical component analysis, transformer and load modeling, symmetrical and unsymmetrical fault analysis, power flow, and power system stability.

Course Learning Outcome:

At the end of the course the student would be able to:

1. Develop proper mathematical models for analysis of a selected problem like load flow study or fault analysis.
2. Select and identify the most appropriate algorithm for load–flow and short circuit studies
3. Develop power system software for static power system studies

EPS5031 Advanced Computer Methods in Power Systems

Syllabus

Unit 1: **6 hrs**

Basic Definitions, Power Factor Improvement Methods, Distribution Network and its Efficiency Calculations

Unit 2: **6 hrs**

Fault Studies -Analysis of balanced and unbalanced three phase faults – fault calculations – Short circuit faults – open circuit faults.

Unit 3: **6 hrs**

Load Flow - Network modeling – Conditioning of Y Matrix – Load flow-Newton Raphson method- Decoupled – Fast decoupled Load flow -three-phase load flow.

Unit 4: **6 hrs**

DC power flow –Single phase and three phase -AC-DC load flow - DC system model – Sequential Solution Techniques – Extension to Multiple and Multi terminal DC system – DC convergence tolerance – Test System and results.

Unit 5: **6 hrs**

Optimal power flow studies, application of conventional methods and genetic algorithm for OPF studies.

Unit 6: **6 hrs**

State Estimation– method of least squares – statistics – errors – estimates – test for bad data structure and formation of Hessian matrix – power system state estimation

Reference Books:

1. Grainger, J.J. and Stevenson, W.D. "Power System Analysis" , Tata McGraw hill, New Delhi, 2003.
2. Arrillaga, J and Arnold, C.P., "Computer analysis of power system" , John Wiley and Sons, New York, 1997.3.
3. J.Arrilaga and C.P. Arnold: Computer Modeling of Electric Power Systems, John Wiley & Sons, N.Y., 1st edition, 2001.

First Year PG Electrical/Power System
EPS5051 Power System Dynamics

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
4	-	--	4	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

This is a core course in F.Y. M.Tech program in Semester I. The robustness of a power system is measured by the ability of the system to operate in a state of equilibrium under normal and perturbed conditions. This course deals with the study of the behavior of power system under conditions such as sudden changes in load or generation or short circuits on transmission lines. This will extend the student to make a mathematical model of synchronous machine. The course will also include Excitation system and prime mover controller. This course will focus on importance of maintaining stability in the power system.

Course Learning Outcomes:

1. Understand fundamental dynamic behavior and controls of power systems and to perform basic stability analysis.
2. Model synchronous generators, transmission lines, excitation systems.
3. Illustrate small signal stability of single and multi-machine system.

EPS5051 Power System Dynamics

Syllabus

Unit 1: 8 hrs

Introduction to basic concept of Power System Stability, States of operation and System Security, System Dynamics Problems, Review of Classical Model , System Model, Analysis of Steady State Stability and Transient Stability

Unit 2: 8 hrs

Modeling of Synchronous Machine, Park's Transformation, Analysis of Steady State Performance, pu. Quantities, Equivalent Circuit of Synchronous Machine

Unit 3: 8 hrs

Excitation system and Prime Mover Controllers: Simplified Representation of Excitation Control, Excitation system, Modeling, standard. Block Diagram, State Equations, Prime Mover Control System, Transmission Line and Load Modeling

Unit 4: 8 hrs

Dynamics of Synchronous Generator Connected to Infinite Bus System Model, Synchronous Machine Model, System Simulation, Consideration of other Machine Models including SVC Model

Unit 5: 8 hrs

Small signal Stability -Single and multi-machine system, Damping and Synchronizing torque Analysis, Power System Stabilizers

Unit 6: 8 hrs

Transient Stability and Voltage Stability Evaluation and Simulation, application of energy functions for direct stability evaluation, TS controllers. Voltage Stability: Introduction, affecting factors, analysis, comparison with angle stability

References

1. K. R. Padiyar, "Power System Dynamics" – Stability and Control, BS Publications
2. I.J. Nagrath and M. Gopal, Control system engineering, Wiley Eastern Ltd, 3rd edition, 2000.
3. Benjamin C. Kuo, Automatic Control system, Prentice Hall of India Pvt Ltd.
4. Prabha Kundur, Power System Stability and Control , Tata McGraw Hill

First Year PG Electrical/Power System
EPS5071 Power System Deregulation

Teaching Scheme				Evaluation Scheme				
					Theory (Marks %)		Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing	Max	Min for Passing
3	1	--	4	ISE	20	40	--	--
				MSE	30		--	--
				ESE	50	40	--	--

Course Description:
This is a core course in F.Y. M.Tech program in Semester I. The deregulation of a power system is measured by the utility model and group generation or independent system operator. The system electric pricing. This course deals with the study of the behavior of power system under conditions such as short time price or long time pricing. Study of Power system operation in competitive environment

Course Learning Outcomes:

1. Understand of operation of deregulated electricity market systems
2. Summarize electricity market prices
3. Analyze various types of electricity market operational and control issues using new mathematical models.

EPS5051 Power System Deregulation

Syllabus

Unit 1: Restructuring models 6 hrs

Introduction – Gencos – Discoms–Independent system operator (ISO) – power exchange, Models based on Trading – Models based on transactions – Hybrid model – market operations – market power – standard cost.

6 hrs

Unit 2: Transmission pricing

Cost Components – Postage Stamp method – Megawatt Mile method – Contract Path Method. Congestion pricing – Preventive and corrective measure – management of inter zonal/intra zonal congestion

6 hrs

Unit 3: OASIS

Open Access Same–time Information System – structure of oasis – pooling of information – transfer capability on OASIS.

6 hrs

Unit 4: Electricity Pricing

Introduction – electricity price volatility electricity price indexes – challenges to electricity pricing – construction of forward price curves – short–time price forecasting – ANN based price forecasting

Unit 5: Power system operation in competitive environment 6 hrs

Introduction – operational planning activities of ISO – the ISO in pool markets – the ISO in bilateral markets – operational planning activities of a Genco

6 hrs

Unit 6: Ancillary services management

Introduction – reactive power as an ancillary service – a review – synchronous generators as ancillary service providers

References

1. Kankar Bhattacharya, Math H.J. Bollen and Jaap E. Daalder: Operation of Restructured Power Systems, Springer Publishers, 2001.
2. Mohammad Shahidehpour and Muwaffaqalomoush – Restructured Electrical Power Systems, 1st Edition, Marcel Dekker, Inc., 2001.
3. Loi Lei Lai, 'power system restructuring and Deregulation' , John Wiley & Sons Ltd., England

First Year PG Electrical Power System
EPS5091 Distribution System Planning and Automation

Teaching Scheme				Evaluation Scheme				
					Theory (Marks %)		Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing	Max	Min for Passing
3	1	--	4	ISE	20		--	--
				MSE	30	40	--	--
				ESE	50		--	--

Course Description:

This course is introduced to cater the students about power distribution system planning. This distribution planning deals with load forecasting, different load models and study of distribution transformer. Also this course covers various aspects of distribution automation.

Course Learning Outcomes:

1. Understand and distinguish characteristics of distribution systems from transmission systems
2. To design, analyze and evaluate distribution system design based on forecasted data
3. Identify and select appropriate sub–station location
4. Design and evaluate a distribution system for a given geographical service area from alternate design alternatives
5. Understand the importance of automation and use of SCADA

First Year PG Electrical Power System
EPS5111 Design and Testing of High Voltage Apparatus

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
3	1	--	4	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

This course is introduced to cater the new trend of high voltage equipments and its use for HVAC transmission. This course also covers the design aspects of high voltage equipments and supported structure. The behavior of high voltage equipments at the time of partial discharge and insulation characteristics is observed.

Course Learning Outcomes:

1. Design a compact and economical insulation structure for high voltage equipment
2. Estimate electric field intensity of various electrode configurations for high voltage power equipment
3. Understand the testing methods of High Voltage Equipment

EPS5111 Design and Testing of High Voltage Apparatus
Syllabus

Unit 1: History of high voltage engineering 6 hrs

Overhead lines – Towers and supports – conductors – dampers – foundations – Insulator design.

Unit 2: Components of insulated power cable 6 hrs

Design features Testing – diagnostics. Types of bushings – Bushing design – Bushing applications – Testing – maintenance and diagnosis

Unit 3: HV Power transformer 6 hrs

Transformer–Insulation design concepts – winding short circuit forces and testing.

Unit 4: HV generation 6 hrs

Methods of generation of high direct voltages – alternating voltages and impulse voltages – insulation coordination

Unit 5: HV measuring system 6 hrs

Test conditions. Introduction – Measuring system – Amplitude measurement of direct voltage – alternating voltage

Unit 6: Impulse measurement 6 hrs

Impulse current measurement of time parameters – optical fiber based monitoring of high voltage power equipment

Reference:

1. H.M. Ryan: High Voltage Engineering & Testing, IEE Press
2. Ravindra Arora & Wolfgang Mosch: High voltage Insulation Engineering, New Age International Publishers, 2011

First Year PG Electrical Power System
EPS5131 Advanced Controls of Electric Drives

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	1	--	4	ISE	20			--	--
				MSE	30		40	--	--
				ESE	50	40		--	--

Course Description:

This course is offered as course for post graduate students of Electrical Power System Program in the first semester. This course deals with control techniques for electrical drives. This course give preliminary knowledge about basic electrical drives used in power electronics.

Course Learning Outcomes:

1. This course is intended primarily to provide a fundamental knowledge of modeling, analysis and integration of Electrical components
2. This course covers the theory and basic principles of power electronic controllers

EPS5131 Advanced Controls of Electric Drives
Syllabus

Unit 1: **6hrs**

Need for advanced controls, Important factors affecting the choice of drive, Parameter identification techniques for electric motors, Electromagnetic compatibility of electrical drives, Different options for an adjustable speed electric drive, Simulation of electrical drives

Unit 2: **6 hrs**

Advanced control strategies for electrical drives. DC drives open and closed loop control. Induction m/c modeling and transformations

Unit 3: **6 hrs**

Scalar control open loop and closed loop control. Vector control, direct and indirect vector control. Direct torque control

Unit 4: **6 hrs**

Inverter , operation principle , Inverter Switching , unipolar , Bipolar , Inverter Dead Time ,Inverter Modulation , Different Types , Sine Triangle Analysis of Sine Triangle Modulation , Trapezoidal Modulation ,Third harmonic Modulation ,, Analysis of Third harmonic Modulation , output filter requirement for different PWM Techniques

Unit 5: **6 hrs**

VSI operated in square wave Mode , Synchronously Rotating Reference frame ,Space Vector Modulation (SVM) , Harmonic losses for SVM , placement of the Zero space vector , Discontinuous Modulation , phase lag Reference for Discontinuous PWM , Harmonic losses for Discontinuous PWM , Single edge SVM , Switched pulse sequence

Unit 6: Transients in Integrated Power System **6 hrs**

DC and AC Servo drives - block diagram, control strategies. Diagnosis of electrical drives, networking of electric drives, Ethernet communication.

References:

1.Bimal K Bose, "Power Electronics and Variable Frequency Drives - Technology and Application", IEEE Press,1997.
2.Grafame Holmes. D and Thomas A. Lipo, Pulse Width Modulation for Power Converters- Principles andPractice- IEEE Press, 2003
3. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990.

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Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
--	--	2	1	ISE	--	--	--	50	50
				ESE	--	--		50	50

It should consist of minimum 8 to 10 practical/simulation assignments.

EPS5191 Power System Dynamics Lab

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
--	--	2	1	ISE	--	--	--	50	50
				ESE	--	--		50	50

It should consist of minimum 8 to 10 practical/simulation assignments.

EPS5211 Seminar I

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
--	--	2	1	ISE	--	--	--	100	50

It should based on recent research articles in peer revived journals or industry case study

EPS5231Research Methodology lab

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
--	--	2	1	ISE	--	--	--	100	50

First Year PG Electrical Power System

IE5231 Proficiency in Technical Communication

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
-	-	2	1	ISE	--	--	--	100	50

Course Objective:

1. To demonstrate knowledge and skills to formulate various types of business and technical communication.
2. To analyze rhetorical aspects of audience, purpose, and context of technical information to effectively communicate through written, oral, and visual media.

Course Learning Outcomes (CLOs):

1. To prepare documents that are structurally and technically appropriate.
2. To enhance writing skills with clarity, conciseness, coherence, cohesion, and emphasis.
3. To develop strategies for any Communication to address diverse forums.
4. Learn to listen actively and Efficiently
5. To enhance Inter-personnel interaction & interviewing techniques.

Course Prerequisite:

1. Student should have adequate knowledge of basic Grammar of English Language.
2. Student should have basic knowledge about Written Communication.
3. Student should have basic knowledge about presentation tools.
4. Student should be able to moderately communicate in English.

IE5231 Proficiency in Technical Communication

Syllabus

1. **Language for Technical Purpose and Presentation Tools**:- Technical vocabulary, Sentence structures, Microsoft office, Graphical presentations — 02 Hrs.
2. **Formal Written Communication**:- Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules. — 02 Hrs.
3. **Project and Research Proposals**: - What's a research proposal? Essentials, Abstract, Aims, Background & significance, Design & methods, Writing a sample proposal. — 02 Hrs.
4. **Project Reports**:- Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. Writing a sample report. — 02 Hrs.
5. **Team Building and Working in Groups**:- Need of team, Effective teams, Group development, Roles in group, Case studies. — 02 Hrs.
6. **Leadership Skills**:- Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies. — 02 Hrs.
7. **Business Meetings**:- Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, conducting meetings effectively, Taking notes and publishing minutes and concluding meetings, action plans, Demo meetings. — 02 Hrs.
8. **Presentation Skills**:- Preparation, Understanding audience, Use of presentation tools, Presentation, non verbal techniques, handling questions, Demo presentations. — 02 Hrs.

References Books:

1. S. Hariharan, et.al. Soft Skills; MJP Publishers, 2010.
2. John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
3. Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
4. Jeff Butterfield,Soft Skills for Everyone,cengage Learning India Private Limited,2010.
5. L. Ann Masters & Harold R. Wallace, Personal Development for Life & Work,10e,Cengage Learning India Private Limited,2011.

Rajarambapu Institute of Technology, Rajaramnagar.

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First Year M. Tech Electrical (Power System)

Syllabus Structure Semester I

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
							Max	Min for Passing	Max	Min for Passing
EPS5011	Research Methodology	2	--	-	2	ISE1	20	40	--	--
						MSE	30		--	--
						ESE	50	40		
EPS5031	Advanced Computer Methods in Power Systems	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5051	Power System Dynamics	4	--	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5071	Power System Deregulation	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
PE I	Program Elective I (List attached)	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5171	Advanced Computer Methods in Power Systems Lab	--	--	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EPS5191	Power System Dynamics Lab	--	--	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EPS5211	Seminar I	--	--	2	2	ISE	--	--	100	50
EPS5231	Research Methodology Lab	--	--	2	1	ISE	--	--	100	50
IEO5231	Proficiency in Technical Communication	--	--	2	1	ISE	--	--	100	50

Total Credits: 24, Total Contact Hours/Week: 28

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updated 5/11/2016

First Year M. Tech Electrical (Power System)

Syllabus Structure Semester II

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
							Max	Min for Passing	Max	Min for Passing
SHP504	Advanced Engineering Mathematics	4	-	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5041	Digital Protection of Power System	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5061	Power System planning and Reliability	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
PE II	Program Elective II (List attached)	3	1	--	4	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
IEO	Institute Elective II (List attached)	3	-	--	3	ISE	20	40	--	--
						MSE	30		--	--
						ESE	50	40	--	--
EPS5181	Digital Protection of Power System Lab	--	--	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EPS5201	Power System Optimization Techniques Lab	--	--	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EPS5221	Seminar II	--	--	2	2	ISE	--	--	100	50
EPS5241	Comprehensive Viva Voce	-	-	-	1	ESE	-	-	100	50

Total Credits: 24, Total Contact Hours/Week: 25

Implemented from 2015-16

Second Year M. Tech Electrical (Power System)

Program Elective I

Course Code	Name of Course
EPS5091	Distribution System Planning and Automation
EPS5111	Design and Testing of HV Apparatus
EPS5131	Advanced Controls of Electric Drives

Program Elective II

Course Code	Name of Course
EPS5081	Integrated Resource Planning
EPS5101	Smart Grid Technologies and Applications.
EPS5121	Economic Operation of Power Systems

First Year PG Electrical Power System
SHP504 Advanced Engineering Mathematics

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
4	1	--	4	ISE	20			--	--
				MSE	30		40%	--	--
				ESE	50	40		--	--

Course Discription:

The objective of the course is to develop level of mathematical sophistication that is appropriate and expected in the Engineering Profession, to understand the impacts of engineering solutions as well as to motivate them to apply their applications to engineering problems and to understand the impacts of engineering solutions as well as to motivate them to apply their applications to engineering problems

Course Learning Outcomes

On completion of this course student will be able to:

1. Identify, formulate and analyze the engineering problem.
2. Apply Mathematical concepts effectively to engineering fields.
3. Find Laplace & Fourier Transforms and inverse Laplace & Fourier transforms of various functions and apply it to solve differential equations
4. Explain and apply the concepts of Probability, Distributions and Joint Probability Distributions.
5. Apply the knowledge of theory of Partial Differential Equations, Matrices, to solve problems in mathematics as well as allied engineering areas.
6. To understand the concept of Complex Analysis and its applications.

5/1/16

SHP504 Advanced Engineering Mathematics Syllabus

Unit 1: Laplace Transforms & Z-Transform **6 hrs**

Concept of Transforms, Laplace Transform (LT) and its existence, Properties of Laplace & Z-Transform, Evaluation of inverse Laplace & Z-Transform & applications

Unit 2: Fourier Transforms **8 hrs**

Introduction, Fourier Integral Theorem, Fourier Sine and Cosine Integral, Complex form of Fourier Integrals, Fourier Transforms, Inverse Fourier Transform, Properties, Modulation Theorem, Convolution Theorem for Fourier Transforms, Parseval's Identity, Fourier Transforms of derivative of functions, Relation between Fourier and Laplace transform.

Unit 3: Linear Algebra& Regression Analysis **8 hrs**

Matrices, eigen values and eigen vectors Correlation, Karl Pearson's coefficient of correlation, Correlation coefficient for a bivariate distribution, Regression coefficient, regression lines, Reliability of regression estimates

Unit 4: Theory of Complex variables **8 hrs**

A review of concept of limit, continuity, differentiability & analytic functions. Cauchy Riemann Equations, Line Integral in the complex plane, Cauchy Integral Theorem & Cauchy Integral Formula & its consequences, Power series & Taylor Series(in brief) ,Zeros & Singularity, Laurent' Series, Residues, Evaluation of Real Integrals

Unit 5: Probability and distributions **8 hrs**

Random Variables: Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function. Standard Distributions: Uniform, Binomial, Geometric, Negative Binomial, Poisson, Exponential, Gamma, Normal.

Unit 6: Optimization Techniques **8 hrs**

Basic concept of optimization, classification of optimization, optimization techniques, and engineering applications of optimization, Classical optimization techniques: unconstrained optimization single-variable optimization, multivariable optimization, multivariable optimization with equality constraints: solution by direct search method, solution by Lagrange-multipliers method, multivariable optimization with inequality constraints, Kuhn-Tucker conditions Introduction to Computational Game theory

Text Books: 1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers39th edition

2.N.P.Bali, Ashok Saxena and N.Ch. S. N. Iyengar, A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi, sixth edition, 2004

Reference Book:

1. P. N. Wartikar and J. N. Wartikar, A Text Book of Applied Mathematics, Vol. I, Vol. II, Vidhyarthi Griha Prakashan, Pune. Nineth Revised Edition, October1984, Reprints: September 2005
2. Ch.V. Raman Murty, N. C. Srinivas, Applied Mathematics, S. Chand and Company Ltd. Ramnagar, New Delhi,First edition, 2001
3. Kreyszig E., Advanced Engineering Mathematics, Wiley Eastern,8 th edition, 2007
4. An Introduction to Game Theory, J. Osborne, Oxford University Press, 2004

First Year PG Electrical Power System
EPS5041 Digital Protection of Power System

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	1	--	4	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

This course is a core course in F.Y. M. Tech program in Semester II. In this course students will learn various recent trends in power system protection. This will extend the student to obtain solutions for setting different relays. The course will also include the system relaying control for important equipments in power system. This course will focus on importance of maintaining safety in power station. Finally, this course will provide a various application oriented examples of design of protective system with view of different equipments.

Course Learning Outcomes:

1. Applying the necessary protection scheme for modern power system equipments.
2. Enhance the protective devices used in power system.
3. Understand the need of computer application in power system protection.

EPS5041 Digital Protection of Power System

Syllabus

Unit 1: Introduction to computer relaying **6 hrs**

Development and historical background, expected relay architecture, A-D converters, Anti –aliasing Filters, functions of a protective system, Protection of transmission lines, Transformers, Reactors and generator Protection, Bus Protection, Performance of current and voltage protection

Unit 2: Transmission line relaying algorithms **6 hrs**

Introduction, sources of error, relaying as parameter estimation, Symmetrical component distance relay, Protection of series compensated lines

Unit 3: Protection of transformers, Machines and buses **6 hrs**

Power transformer algorithms, digital protection of generators and motors.

Unit 4: System relaying and control **6 hrs**

Measurement of frequency and phase, sampling clock synchronization, Application of phase Measurements to static and dynamic state estimation, system monitoring.

Unit 5: Development in new relaying principles **6 hrs**

Travelling waves in single phase and three phase lines travelling waves due to faults, directional wave relay, Travelling wave distance relay

Unit 6: Hardware organization **6 hrs**

Integrated and multifunction protection schemes -SCADA based protection system- FTA, Testing of Relays

References:

1. "Power system Protection and Switchgear", Badri Ram and D.N. Vishwakarma.
2. "Protective Relays". Vol I and II, Warrington and Collins
3. "Protective relaying for Power system", Edited by Stanley .H. Horowitz, IEEE Press

First Year PG Electrical Power System
EPS5061 Power System Planning and Reliability

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	1	--	4	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

This course is offered as course for post graduate students of Electrical Power System Program in the second semester. The importance of power and energy in modern society is well established and it is impossible to create a modern society and country without power network expansion and existence of reliable power system operation. The continued development of reliable system has been the main focus of power and energy system engineers for over a century. This course will provide understanding of tools used for optimal expansion of generation, transmission and distribution system and estimating reliability indices.

Course Learning Outcomes:

1. Explain the need of power system expansion.
2. Analyze the given power system for determining optimal values of decision variables.
3. Apply mathematical tools to solve multi-objective optimization problems in expansion planning and reliability studies

EPS5061 Power System Planning and Reliability
Syllabus

Unit 1: Load Forecasting **6hrs**

Objectives of forecasting - Load growth patterns and their importance in planning – Load forecasting Based on discounted multiple regression technique-Weather sensitive load forecasting-Determination of annual forecasting-Use of AI in load forecasting.

Unit 2: Generation System Reliability Analysis **6 hrs**

Probabilistic generation and load models- Determination of LOLP and expected value of demand not served –Determination of reliability of ISO and interconnected generation system.

Unit 3: Transmission System Reliability Analysis **6 hrs**

Deterministic contingency analysis-probabilistic load flow-Fuzzy load flow probabilistic transmission system reliability analysis-Determination of reliability indices like LOLP and expected value of demand not served.

Unit 4: Expansion Planning **6 hrs**

Basic concepts on expansion planning-procedure followed for integrate transmission system planning, current practice in India-Capacitor placer problem in transmission system and radial distributions system

Unit 5: Distribution System Planning Overview **6 hrs**

Introduction, sub transmission lines and distribution substations-Design primary and secondary system-distribution system protection and coordination of protective devices

Unit 6: Adequacy and Security Measures considering wind power **6 hrs**

Wind Power Generation Model, Wind Farm Modeling, case study, Adequacy-Based Comparison, Security-Based Comparison

References:

1. R.L .Sullivan, "Power System Planning".McGraw Hill, New York, 1977.
2. Roy Billinton and Ronald.N.Allan, "Power System Reliability.", Springer, 1996
3. Turan Gonen, Electric power distribution system Engineering „McGraw Hill, 1986

First Year PG Electrical Power System
Program Elective II

EPS5081 Integrated Resource Planning

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	1	--	4	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

The present energy scenario is not satisfactory. The power supply position prevailing in the country is characterized by persistent shortages and unreliability and also high prices for industrial consumer. There is also concern about the position regarding petroleum products. We depend to the extent of more than 70 percent on imported oil, and this naturally raises issues about energy security. These concerns have been exacerbated by recent movements in international oil prices. Electricity is domestically produced but its supply depends upon availability of coal, exploitation of hydro power sources and the scope for expanding nuclear power, and there are constraints affecting each source.

Course Learning Outcomes:

1. Understand how to do calculations and analyzing the cost effectiveness of energy conservation measures against conventional supply-side options.

2. Evaluate various tools for IRP and DSM

EPS5081 Integrated Resource Planning
Syllabus

Unit 1: Energy services and energy efficiency **6 hrs**

Introduction, Energy sources, carriers and uses, the human dimension of energy, energy balance accounting IRP and the traditional power-planning approach, outline of an IRP Process, IRP options, who carries out the IRP analysis? , IRP in the Context of Deregulation

Unit 2: The technological structure of energy demand projections and scenarios **6 hrs**

Models to Analyze and Forecast Energy Demand, Scenario-Based Projections Framework: Baseline growth projection scenario, technical potential scenario, economic potential scenarios, market potential scenarios.

Unit 3: Energy Economics **6 hrs**

Fundamentals of Economics of Energy Conservation: Discount rate, present value, net present value(NPV), life cycle cost(LCC), annualized life cycle cost (ALCC) etc

Unit 4: Renewable, Energy-Efficiency Programs, And demand-Side Management **6 hrs**

Energy Pricing: Block Tariffs, Marginal Cost Pricing, Demand Charges, Time-of-Use, and Seasonal Pricing, Green Pricing and other incentive/benefits. Demand-Side Management (DSM) Strategies: Load Management, Investments in Energy Efficiency and DSM Program, Evaluation of DSM Programs

Unit 5: Least Cost Power Planning Aspects **6 hrs**

Electricity Production Costs: Utility Revenue Requirements, Marginal Energy and Capacity Costs, Capacity Factor and Load Factor Environmental and Social Cost Analysis: Environmental Impacts of Electricity Production , Emissions Accounting and Environmental Impacts , Externality Values, Costs of Emission Reductions

Unit 6: Integrating Energy Demand Side Options and Supply Option **6 hrs**

Defining Scenarios and Baselines, Combining DSM and Supply Resource Options, Ranking the Resource Options by Marginal Cost, Estimating Impacts on Electricity Rates, Accounting for Intermittent Supply Resources

References:

1. " Tools and methods for integrated recourses planning " by Joel N Swisher, Gilberto de Martino jannuzzi & Robert Y Redlinger UNEP collaborating centre on energy and environment Riso national laboratory Nov 1997
2. " Integrated Energy policy " report of the expert Committee, Government of India Planning Commission August 2006

First Year PG Electrical Power System
Program Elective II

EPS5101 Smart Grid Technologies and Apparatus

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
3	1	--	4	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

This course is offered as Elective for post graduate students of Electrical Power System Program in the second semester. This course deals with applications of renewable sources for developing smart grid in standalone and interconnected power system.

Course Learning Outcomes:

1 Understand features of Smart Grid in the context of Indian Grid
2 Assess the role of automation in Transmission/Distribution
3 Understand operation and importance of PMUs, PDCs, WAMS, Voltage and Frequency control in Micro Grids.

EPS5101 Smart Grid Technologies and Apparatus
Syllabus

Unit 1: Introduction to Smart Grid **6 hrs**

What is Smart Grid? Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid

Unit 2: Smart Grid Architecture **6 hrs**

Components and Architecture of Smart Grid Design – Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs – Transmission Automation – Distribution Automation – Renewable Integration

Unit 3: Tools and Techniques for Smart Grid **6 hrs**

Computational Techniques – Static and Dynamic Optimization Techniques – Computational Intelligence Techniques – Evolutionary Algorithms – Artificial Intelligence techniques

Unit 4: Distribution Generation Technologies **6 hrs**

Introduction to Renewable Energy Technologies – Micro grids – Storage Technologies –Electric Vehicles and plug – in hybrids – Environmental impact and Climate Change – Economic Issues.

Unit 5: Communication Technologies and Smart Grid **6 hrs**

Power Quality and EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Unit 6: Control of Smart Power Grid System **6 hrs**

Load Frequency Control (LFC) in Micro Grid System – Voltage Control in Micro Grid System – Reactive Power Control in Smart Grid. Case Studies and Test beds for the Smart Grids

References:

1. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley–IEEE Press, 2004.
3. A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer Edition, 2010.
4. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2005.

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First Year PG Electrical Power System
Program Elective II

EPS5121 Economic Operation of Power Systems

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
3	1	--	4	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

This course is offered as Elective for post graduate students of Electrical Power System Program in the second semester. This course deals with control and operation of grid connected power system for economic scheduling. It also consist of unit commitment and material and energy balance.

Course Learning Outcomes:

1. Analyze Thermal and Hydro generator characteristics and their economic operation
2. Examine the Unit Commitment problem with various constraints using conventional optimization techniques
3. Summarize ELD, UC and AGC problems using Heuristic techniques.

EPS5121 Economic Operation of Power Systems
Syllabus

Unit 1: Economic dispatch **6 hrs**

ED problem and methods of solutions – Economic importance – Characteristics of steam units. Economic dispatch of Thermal Units and methods of solutions – problem considering and neglecting transmission losses

Unit 2: Iterative and non–iterative methods of solutions **6 hrs**

Economic dispatch using dynamic programming.
Unit Commitment – Definition – Constraints in Unit Commitment–Unit Commitment solution methods – Priority–List Methods – Dynamic Programming Solution

6 hrs

Unit 3: Economic dispatch versus Unit Commitment

Constraints in thermal and hydro–units – hydro thermal coordination

Unit 4: Long range and short–range hydro–scheduling **6 hrs**

Dynamic programming solution to hydro–thermal scheduling.

Unit 5: Control of generation **6 hrs**

Models of power system elements – single area and multi area block diagrams – generation control with PID controllers – implementation of Automatic Generation control (AGC) – AGC features.

Unit 6: Material and Energy Balance **6 hrs**

Economic dispatch by ANN and GA approaches.

References:

1. Allen J. Wood & B.F. Woolenberg: Power Generation, Operation and Control, Wiley India Pvt. Ltd., 2nd edition, 2006.
2. John J. Grainger and William D Stevenson: Power System Analysis, McGraw Hill ISE, 1st edition 2003.
3. PSR Murthy: Operation & Control in Power System, BS Publications, 2nd edition, 2009

First Year PG Electrical Power System
EPS5181 Digital Protection of Power System Lab

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
--	--	2	1	ISE	--	--	--	50	50
				ESE	--	--		50	50

It should consist of minimum 8 to 10 practical/simulation assignments.

First Year PG Electrical Power System
EPS5201 Power System Optimization Techniques Lab

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
--	--	2	1	ISE	--	--	--	50	50
				ESE	--	--		50	50

It should consist of minimum 8 to 10 practical/simulation assignments.

First Year PG Electrical Power System
EPS5221 Seminar II

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
--	--	2	2	ISE	--	--	--	100	50

First Year PG Electrical Power System
EPS5241 Comprehensive Viva Voce

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
	--	-	1	ESE	--	--	--	100	50

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FY M Tech Semester II
List of Institute Elective Courses

Course Code	Course Title	Department	Applicable to Students of following Departments
IET5021	Electric and Hybrid vehicles	Automobile Engineering	Automobile/Mechanical/ Electrical/ Electronics
IET5041	Advance Networks	Computer Sc.& Engineering	Electrical/ Electronics/ CSE
IET5061	Value Engineering	Civil Engineering	Automobile/Mechanical/ Electrical/ Civil
IET5081	Industrial Safety and Risk Assessment	Civil Engineering	Automobile/Mechanical/ Electrical/ Civil
IET5101	Industrial Automation and Control	Electrical Engineering	Electrical/ Electronics/ Automobile/Mechanical
IET5121	Sensor Technology	Electronics & Telecommunication Engg.	Automobile/Mechanical/ Electrical/ Electronics
IET5141	Mechatronics	Electronics & Telecommunication Engg	Automobile/Mechanical/ Electrical/ Electronics
IET5161	Computational Fluid Dynamics	Mechanical Engineering	Automobile/Mechanical and Civil
IET5181	Quality and Reliability Engineering	Mechanical Engineering	Automobile/Mechanical/ Electrical
IET5201	Computational techniques in design Engineering	Mechanical Engineering	Automobile/Mechanical/ Electrical
IET5221	Management for Engineers	Master of Business Administration (MBA)	All Departments
IET5241	Data Analytics	Master of Business Administration (MBA)	All Departments
IET5261	Innovation Management	Mechanical Engineering	E&TC, Electrical Engg, Civil Engg & CSE programs.

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4/1/16.

F. Y.M. Tech. Semester – II
Department of Automobile Engineering
Institute Elective
IET5021: Electric and Hybrid Vehicles.

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max.	Min. for Passing		Max.	Min. for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

With depleting conventional fuel sources, modern transportation can not rely on only IC Engine powered vehicles. In the pursuit of alternative technologies, Electric and Hybrid electric vehicle technology is coming up in a big way. There are already many EVs and HEVs on roads of developed nations and are being offered as viable means of transportation in developing countries as well. The course offers opportunity for students to learn a modern and relevant technology as a part of the program. Also, with unveiling of National Electric Mobility Mission Plan (NEMMP 2013) recently, many employment opportunities are expected in the area of design and research on EV technology.

COURSE LEARNING OUTCOMES:
At the end of this course student will be able to:

1. Design and EV for given requirements and estimate its performance.
2. Compare Electric and Hybrid electric technology and its various subsets.
3. Select appropriate configuration/s and control strategy for HEVs.
4. Choose appropriate power source of correct rating for the EVs and HEVs.
5. Describe the fuel cell technology and model the FCEV for the road application.

PRE-REQUISITES:
A basic course on Automobile Engineering and Electrical Machines is recommended as pre-requisites for this course.

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Unit 1: Introduction and conventional drive train
Environment impact, history of EVs, conventional drive train elements, formats and design principles

Unit 2: Electric vehicles technology and design
Configurations of EVs, performance, energy consumption, design issues

Unit 3: Hybrid electric vehicle technology
Concept, architecture of hybrid drive trains, series hybrid drive train and parallel hybrid drive train

Unit 4: Design of series and parallel hybrid drive trains
Operation patterns, design objectives, control strategies, sizing of components

Unit 5: Peaking power sources and Drives for EVs
Electrochemical batteries, ultra capacitors, ultra high speed flywheels, motors used for EVs and HEVs

Unit 6: Fuel Cell Electric Vehicle Drive Train Design
Fuel cell technology, configuration, control strategy, parametric design

Reference Books:-

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design', CRC Press, New York, 2010.
2. Robin Hardy, Iqbal Husain, 'Electric and Hybrid Vehicles', CRC Press, ISBN 0-8493-1466
3. James Larminie, John Lowry, 'Electric Vehicle Technology Explained', John Wiley & Sons Ltd., England, 2003.
4. Iqbal Hussain, 'Electric & Hybrid Vehicles – Design Fundamentals', CRC Press, New York, 2003.
5. Sandeep Dhameja, 'Electric Vehicle Battery Systems', Newnes, Massachusetts, 2002.
6. Dr Mike Westbrook, M H Westbrook, 'The Electric Car: Development & Future of Battery, Hybrid Cars', British library Cataloguing in Publication Data, UK, ISBN0 85296 0131.

F. Y.M. Tech. Semester – II
Department of Computer Science & Engineering
Institute Elective
IET5041: Advance Networks

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max.	Min. for Passing		Max.	Min. for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:
Communication is one of the fundamental applications of computer systems. Wireless technologies are becoming popular in these days. This course will cover the fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks providing insight and knowledge about architectures and protocols for Mobile and wireless communication. The course discusses about Wireless LAN, Emerging Wireless Technology, and Technologies for Mobile communication. It also focuses on fundamental of Wireless ad-hoc network, its routing protocols and Wireless Sensor Network.

Course Learning Outcomes:
At the end of course student should be able to,

- Comprehend the concepts of Wireless LAN.
- Differentiate between the technologies and protocols used in wireless and mobile communication.
- Discuss the concepts of Wireless Ad-hoc Network.
- Simulate and analyze the routing protocols used in Wireless Ad-hoc Network.
- Formulate and solve problems in Wireless Sensor Network.

Prerequisites: Basics of Computer Network.

Unit 1: Wireless LAN	06
Introduction, advantages, IEEE 802.11 standard, Wireless LAN Architecture, Mobility in Wireless LAN, Deploying Wireless LAN, Mobile Ad-hoc Network and Sensor Network, Wireless LAN security, Wireless Access in Vehicular Environment, Wireless Local Loop, HiperLAN, WiFi versus 3G.	
Unit 2: Emerging Wireless Technology	**06**
Introduction, Bluetooth, Radio Frequency Identification (RFID), Wireless Broadband (WIMAX), Mobile IP, Internet Protocol Version 6 (IPV6).	
Unit 3: Technologies for Mobile Communication	**06**
Global System for mobile communication (GSM), Short Message Service (SMS), General Package Radio Service (GPRS), Wireless Application Protocol (WAP), CDMA and 3G.	
Unit 4: Ad-hoc Wireless Network	**06**
Introduction to Ad-hoc Wireless Networks, Overview, Characteristics, Applications, Issues in Ad Hoc wireless networks, MAC Protocols for ad hoc wireless networks: Introduction, Issues in designing MAC protocol, Design goals of MAC protocol, Classification of MAC protocols, Contention based protocols.	
Unit 5: Routing Protocol in Ad-hoc Wireless Network	**06**
Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols: Table driven, on-demand Hybrid routing protocols, Issues in designing a multicast routing protocol, Operation of multicast routing protocols, An architecture reference model for multicast routing protocols, Classification of multicast routing protocols, Tree-based, Mesh-based multicast routing protocols.	
Unit 6: Wireless Sensor Network	**06**
Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering , MAC Protocols for Sensor Networks, Location Discovery, Quality of Sensor Network ,Other Issues: Energy Efficient Design, Synchronization, Transport Layer Issues, Security , Real Time Communication.	

Text Book:-

1) Asoke K Talukder,Hasan Ahmed , Roopa R. Yavagal , "Mobile Computing : Technology, Applications and service creation" ,2nd edition,Mc Graw Hill publication
2) Yi-Bing and Imrich Chlamtac, "Wireless and Mobile Networks Architectures", John Wiley & Sons, 2001
3) Ad Hoc wireless Networks – Architecture and Protocols by C.S.R.Murthy & B.S. Manoj, Pearson Education

Reference Books:-

1. Wireless communication and Networks by William Stallings , 2nd edition , Pearson Education
2. Imielinski T. and Korth H.F., "Mobile Computing", Kluwer Academic Publishers, 1996.
3. Carlos de Morais Cordeiro and Dharma Prakash Agrawal, "Ad Hoc & Sensor Networks:Theory and Applications", World Scientific, 2007.
4. Toh C. K., "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall, PTR, 2001.

F. Y.M. Tech. Semester – II
Department of Civil Engineering
Institute Elective
IET5061: Value Engineering

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max.	Min. for Passing		Max.	Min. for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:

Value engineering is a structured & systematic problem solving technique or methodology. It is a process that generates alternative solutions using a combination of creative & analytical techniques. It is a multidisciplinary technique & can be successfully applied to any economic activity in trade, industry, commerce, education, transport, civic, administration, healthcare, hospitals, police work, government etc.

Prerequisites:

Basic knowledge of all courses in the discipline.

Course Objectives:

- To introduce the fundamentals of value engineering.
- To know about value engineering job plan.
- To know about managing the value engineering study.
- To understand life cycle cost theory.
- To demonstrate value engineering applications on projects.
-

Course Learning Outcomes:

On completion of this course the student will be able to:

- Explain about concept and fundamentals of value engineering.
- Compose value engineering job plan.
- Construct FAST diagram.
- Decide cost model of a project.
- Analyse life cycle cost.
- Carry out value engineering study of engineering projects.

Syllabus

Unit 1: Introduction **4 hrs**

Concept, theory, fundamentals of VE and types of values.

Unit 2: Value Engineering Job Plan **10hrs**

Information phase, Functional analysis phase, Creative phase, Evaluation phase, Development phase and Presentation/recommendation phase.

Unit 3: Cost Modeling **4 hrs**

Cost validation, Cost estimating and Cost models.

Unit 4: Life-cycle Cost **4 hrs**

Definition, purpose, types and Life-cycle cost analysis.

Unit 5: Managing Value Engineering Study **8 hrs**

Project selection, Team selection, VE job plan, VE change proposal and audit.

Unit 6 : Value Engineering Cases **6 hrs**

Discussion of various applications of neural systems and algorithms.

References

1. Iyer S.S. "Value Engineering" New age international (p.) LTD. Publishers New Delhi 1996.
2. Lawrence D Miles "The techniques of value analysis & engineering"3rd edition published by Eleanor Miles Walker.
3. Mukhopadhyaya A.K. "Value Engineering Concepts. Techniques & applications" Response books, a division of sage publications New Delhi 2004.
4. Zimmerman L.W. & Hart G.D, "Value Engineering a practical approach for owners, designers & contractors" C.B.S. Publishers & distributors, Delhi 1988.

F. Y.M. Tech. Semester – II
Department of Civil Engineering
Institute Elective
IET5081 - Industrial Safety and Risk Assessment

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max.	Min. for Passing		Max.	Min. for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:-

The course 'Industrial Safety and Risk Assessment (ISRA)' is offered as an open Elective for Post-graduate programme (M. Tech) at semester II and is useful in all the streams of engineering. It deals with rational development of safety in engineering industries, hazard analysis and risk assessment. The course includes the application of mathematical tool namely Artificial Neural Network (ANN) for predicting the risks and its assessment. It also focuses on design of safety management systems and legal aspects of safety and hazard control rules in engineering industries.

Pre-requisite – The students should have basic knowledge of various safety aspects involved in their area of field.

Course Learning Outcomes:

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

1. Analyze the root causes and effects of accidents in engineering industries.
2. Explain various methods of analyzing the risks involved in engineering industries
3. Assess the effects of industrial hygiene and occupational health
4. Predict the risks involved in engineering industries by applying mathematical tool such as ANN
5. Design Safety management system for engineering industries
6. Create awareness about legal aspects of safety in engineering industries by implementing safety management plan.

Unit 1: Safety in Engineering Industries **06**

Hazards in Industries, hazardous materials, hazard analysis, Fire hazards, hazards and risks, hazard assessment, methods of hazard analysis

Unit 2: Accidents in Engineering Industries **06**

Sources and types of accidents, Root causes and effects of accidents, Technical analysis of accidents, guidelines for good safety practices, accident preventive techniques.

Unit 3: Risk assessment **06**

Scope of risk assessment, probabilistic risk analysis (PRA), risk perception and acceptability, risk matrix, methods of risk assessment- Fault tree Analysis, event tree analysis etc, Diograph and other approaches

Unit 4: Occupational Health and Industrial Hygiene **06**

Objectives, Chronic and Acute Effects, Various Limits of Exposure- Lethal Dose 50, Lethal concentration 50,Threshold Limit Value etc. Effects of Various Physical, Chemical and Biological Hazards Present in Industries on Human Health.

Unit 5 : Application of mathematical tools for Risk assessment **06**

Introduction to Artificial Neural network (ANN) and its application for risk assessment. Remote sensing and its application for risk assessment

Unit 6 : Legal aspects of Safety in Engineering industries **06**

Industrial safety acts, Major accident hazard control rules, On site and Off site Emergency Management Plan, Design of Safety Management system.

Tutorials:

One hour per week per batch tutorial is to be utilized for problem solving / assignment /industrial visits to ensure that students have properly learnt the topics covered in the lectures. The teacher may add any other academic activities to evaluate in semester performance of students.

References:

1. David L. Goetsch Occupational Safety and health, Prentice Hall, 2002 –184
2. EDEL Engineering consultancy Pvt. Ltd. Safety manual
3. Lee Harrison, Environmental Health and Safety Auditing Handbook , McGraw-Hill, 1999.
4. K Park Banarsidas, Textbook of Preventive and Social medicine, Bhanot Publishers
5. Dr A H Hommadi, Industrial and Occupation safety
6. K T Kulkarni, Introduction to industrial safety
7. Timothy Ross, Neural network and fuzzy logic in engineering Neural network and fuzzy logic in engineering George J Klir, Fussy sets and systems

F. Y.M. Tech. Semester – II
Department of Electrical Engineering
Institute Elective
IET5101: Industrial Automation and Control

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max.	Min. for Passing		Max.	Min. for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

COURSE DESCRIPTION:

The main objective of this course is to make the learners familiarized with the conceptual as well as practical knowledge of the Industrial Automation & latest technologies being used to achieve real time industrial automation. The idea of designing this course is to inculcate the basic fundamentals of automation in the mechanical, automobile, electronics and electrical students and provide them with a platform to work on dissertation work.
The most used guiding force behind an automated industrial plant is a "Programmable Logic Controller" generally known as a PLC. A plc based automated system is an example of a real time system. PLCs along with certain other necessary components like sensors, motors, actuators, valves, conveyors, boilers, SCADA systems, computers & many more, makes a real automated manufacturing plant. Unlike Micro controller based system PLC is designed for multiple inputs and output applications.
The course provides comprehensive coverage of Programmable Logic Controller (PLC) components, industrial detection sensors and their interfacing, fundamental programming language and advanced programming techniques used in industrial automated systems, SCADA system and HMI.

PREREQUISITE: Number system, basic gates, transistor working, electrical wiring (dc supply, ac supply), basic computer knowledge.

COURSE LEARNING OUTCOMES:
After completion of this course students will be able to:

1. List major components for PLC based automation system of given applications.
2. Identify & Use suitable sensors and actuators for the given application.

3. Apply standard programming languages and perform trouble shooting of system.
4. Develop relay logic ladder diagram for the given application.
5. Develop monitoring system for the given real time applications using SCADA/HMI.

Unit 1: Automation Overview **6 hrs**

Brief description of a control system, need of Industrial automation, architecture of Industrial automation, application of industrial automation, Introduction to Programmable Controllers.
Case study: relay logic based control system design

Unit 2: Components and Systems **6 hrs**

Basic components of automation, Processors, the Power Supply, and Programming Devices; The Memory System and I/O Interaction, The Discrete Input/ Output System, The Analog Input/ Output System, Special Function I/O and Serial Communication Interfacing.

Unit 3: PLC Programming **6 hrs**

Programming Languages, the IEC 1131 Standard and Programming Language, System Programming and Implementation, PLC System Documentation.

Unit 4: Ladder logic programming and Applications **6 hrs**

Mathematical, logical, special function and branch instructions, Timer, Counter, Process Controllers and Loop Tuning. Case studies.

Unit 5: Installation & Advanced PLC topics **6 hrs**

PLC Start-Up and Maintenance, System Selection Guidelines, PLC Systems, Fuzzy Logic.
Case study on PLC system

Unit 6: SCADA and HMI **6 hrs**

SCADA System Introduction, creating new project, GUI design, Tag substitutions, Alarms & event, application of scripts, communication with PLC, HMI Introduction, HMI Design, Design cases, practice problems.
Case study on SCADA/HMI based PLC system

References:

1. Frank D. Petruzella, "Programmable Logic Controllers", Fourth edition, Mc Graw Hill
2. W. Bolton, "Programmable Logic Controllers", Fifth edition, Newnes publications
3. John R. Hackworth and Frederick D. Hackworth Jr, "Programmable Logic Controllers Programming, Methods and Applications", PEARSON Publication, 2011.
4. J. W. Webb & R. A. Reis, "Programmable Logic Controllers, PHI company- Fifth Edition, 2005.

F. Y.M. Tech. Semester – II
Department of Electronics & telecommunication Engineering
Institute Elective
IET5121: Sensor Technology
Course Teacher – Dr. M S Patil

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

COURSE DESCRIPTION:

The convergence of the Internet, Communications and Information technologies, coupled with recent engineering advances, is paving the way for a new generation of inexpensive sensors and transducers. This course includes applications of sensors in different multi-disciplinary areas. It also includes Internet of Things which is a way to connect loosely defined smart objects and enable them to interact with other objects, environment.

COURSE OUTCOMES:

After successful completion of course students will be able to

1. Identify the use of sensors in different multi-disciplinary areas.
2. Design an application using suitable sensor.
3. Describe Internet of Things for smart applications.

PREREQUISITES:

Basic knowledge of physics, instrumentation and communication.

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UNIT I **06**

SENSOR ELECTRONICS: sensor data sheets, sensor types, sensor limitations, industrial process control loop, building blocks of a smart sensor, application considerations, sensor characteristics, instrument selection, readout, installation, measurement issues and criteria, sensor signal conditioning

UNIT II **06**

SENSORS APPLICATIONS IN MECHANICAL INDUSTRY: displacement, location and position sensors, strain sensors, motion sensors, pressure sensors, flow sensors-solid flow measurement, liquid flow measurement, vibration monitoring sensors

UNIT III **06**

SENSORS APPLICATIONS IN AUTOMOBILE INDUSTRY: air–fuel ratio meter, crankshaft position sensor, engine coolant temperature sensor, hall effect sensor, map sensor, mass flow sensor, oxygen sensor, parking sensors, speedometer, vehicle speed sensor, throttle position sensor, tire-pressure monitoring sensor, smarter sensors for smart vehicles

UNIT IV **06**

DATA ACQUISITION SYSTEMS: objective of DAS, signal conditioning of the inputs, single channel and multi channel data acquisition systems, data loggers, data transmission, microcontroller based system design & peripheral interfaces

UNIT V **6 hrs**

INTERNET OF THINGS: introduction, basics of IoT, IoT building blocks, web architecture for an IoT, three categories of IoT users, IoT levels, applications of IoT – smart city, smart vehicle, automotive industry, telecommunication industry, medical health care, process industry, retail logistics and supply chain management, environment monitoring, smart tourism.

UNIT VI **06**

RECENT TRENDS IN SENSOR TECHNOLOGY: research papers and articles in sensor and transducer technology from IEEE, IET, Elsevier etc.

REFERENCES

1. Sensor Technology Handbook, Jon S. Wilson, 1st Edition, Elsevier, 2004
2. Process Control Instrumentation Technology, Curtis D. Johnson, 8th Edition, PHI Learning Pvt. Ltd., 2006
3. Electronics Instruments, Kalsi, 3rd Edition, Tata McGraw-Hill Education, 2010
4. Internet of Things-converging technologies for smart environments and integrated ecosystems, Ovidiu Vermesan, Peter Friess, River Publishers series in Communications, 2013
5. Research papers from IEEE, IET, Science Direct
6. http://en.wikipedia.org/wiki/List_of_sensors
7. Sensors Handbook, Sabric Soloman, Mc Graw Hill, 2nd Ed., 2010

F. Y.M. Tech. Semester – II
Department of Electronics & telecommunication Engineering
Institute Elective
IET5141: Mechatronics

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

COURSE DESCRIPTION:

This course is designed to provide a comprehensive coverage of many areas of engineering disciplines that come together to form the field of Mechatronics. The experience is created by using sensors, actuators, electronic circuits, data acquisition system and real time interfacing with design, simulation and modeling. The course ends with case studies.

COURSE OUTCOMES:

After successful completion of this course students should be able to;

1. Study of sensors, actuators, system modeling and design with real-time controller interfacing.
2. Design step-by-step mechatronics system design.
3. Analyze the system for different input and different output.

PREREQUISITE:

Basic knowledge of Engineering.

UNIT I **06**

DATA ACQUISITION SYSTEM: Significance of Data Acquisition System, Generalized Data Acquisition System, Signal conditioning elements used in Data Acquisition Systems, Single channel Data Acquisition System, Multichannel Data Acquisition System, Data Logger, µp/µC based Data Acquisition System, Elements of Data Acquisition and control System.

UNIT II **06**

MECHATRONICS SYSTEM DESIGN, MODELING AND SIMULATION OF PHYSICAL SYSTEMS: What Is Mechatronics, Integrated Design Issues in Mechatronics, the Mechatronics Design Process, Mechatronics Key Elements, Simulation and Block Diagrams, Analogies and Impedance Diagrams, Electrical Systems, Fluid Systems, Electromechanical Coupling.

UNIT III **06**

SENSORS AND TRANSDUCERS: Introduction to Sensors and Transducer, Sensor Classification, Parameter Measurement in Sensors and Transducers, Smart sensors, Performance Terminology, Sensors for Motion and Position Measurement, Force, Torque and Tactile Sensors, Flow sensors, Temperature sensors, Ultrasonic sensors, Range sensors, Fiber optic Liquid level sensor, Active Vibration Control using Magnetostrictive Transducers, Signal conditioning.

UNIT IV **06**

ROBOTICS: Introduction, Types of Robotics, Types of Robot Controls, Robot Drive Systems, Robot End Effectors, Selection Parameter of a Robot, and Selection Parameter for Application Area where a Robot can be Used, Applications of Robots.

UNIT V **06**

ACTUATING DEVICES AND ADVANCED APPLICATIONS IN MECHATRONICS: DC motor, PM Stepper Motor, Fluid Power Actuation, Fluid Power Design Elements, Piezoelectric Actuators, Sensors for Condition Monitoring, Mechatronics Control in Automated Manufacturing, Artificial Intelligence in Mechatronics, Fuzzy Logic Applications in Mechatronics, Micro sensors in Mechatronics.

UNIT VI **06**

CASE STUDIES: Interfacing with microcontroller , Rotary Optical encoder, PH control system and De-Icing temperature control system, Computer based mechatronics case study, etc.

REFERENCE BOOKS:

1. "Mechatronics System Design", Devdas Shetty and Richard A. Kolk, Cengage Learning Publication, second edition, 2011.
2. "Introduction to mechatronics & measurement systems", by Alciatore & Histand, McGraw Hill Publications, second edition, 2002.
3. "Mechatronics – Electronic control system in mechanical engineering" by Bolton, Addison, Pearson Education Asia, 1999.
4. "Mechatronics", by M.D. Singh and J.G. Joshi, PHI publication, 2006.

F. Y.M. Tech. Semester – II
Department of Mechanical Engineering
Institute Elective
IET5161: Computational Fluid Dynamics

Teaching Scheme				Evaluation Scheme					
					Theory (Marks %)			Practical (Marks %)	
L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:-
Computational Fluid Dynamics (CFD) gain knowledge of use of modern CFD software to build, solves, and visualizes fluid-flow models. The course is aimed to give a basic understanding to the discretisation of equations of mass, momentum and energy. The course covers numerical methods for physical simulations of gas and liquid flows. The course is based on the finite volume method and the finite element method with emphasis on fluid dynamics and includes various computational problems in fluid dynamics such as boundary conditions and meshing.

Pre- requisites: -
Thermodynamics, heat transfer and Fluid Mechanics

Course Outcomes: -
At the end of the course the students will be able to: -

1. Solve the basic governing equations and significance of these equations in the field of fluid flow and heat transfer
2. Implement different techniques and solution procedure using different discretization schemes for real field complex problem
3. Modify the available schemes and methods for multi-physics problem
4. Develop suitable simple numerical model.

Unit 1: **Basics of CFD** 6

Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations.

Unit 2: **Governing Equations** 6

Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.

Unit 3: **Finite Volume Method:**

Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach, Problems on discretization 6

Unit 4: **Geometry Modeling and Grid Generation:** 6

Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance. Problems on discretization and modeling of simple equations

Unit 5: **Methodology of CFDHT:** 6

Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation. Simple numerical code using MATLAB or C++ or Fluent.

Unit 6: **Solution of N-S Equations for Incompressible Flows:** 6

Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered Grid System of N-S Equations for Incompressible Flows

Reference Books: -

1. Anderson, J.D.(Jr), Computational Fluid Dynamics, McGraw-Hill Book Company, 1995.
2. Hoffman, K.A., and Chiang, S.T., Computational Fluid Dynamics, Vol. I, II and III, Engineering Education System, Kansas, USA, 2000.
3. Chung, T.J., Computational Fluid Dynamics, Cambridge University Press, 2003.
4. Anderson, D.A., Tannehill, J.C., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, McGraw Hill Book Company, 2002.
5. Versteeg, H.K. and Malalasekara, W., An Introduction to Computational Fluid Dynamics, Pearson Education, 2010.
6. Numerical Methods in Fluid Flow & Heat Transfer by Dr. SuhasPatankar.
7. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.
8. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
9. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa Publication.

F. Y.M. Tech. Semester – II
Department of Mechanical Engineering
Institute Elective
IET5181: Quality and Reliability Engineering

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Corse Description:-
Quality and reliability engineering provides the theoretical and practical methodologies to improve the capability of systems to perform their designated functionalities, to predict the probability of their functioning without failures in certain environments for desired periods, to assess their maintainability, availability and safety based on sampled data, and to make decisions on corrective and mitigation actions.

Prerequisites: -
Knowledge of basic statistical process and terms and their calculations.

Course Outcomes:-
After completion of this course, students will be able to,
1. Calculate failure rates, MTTF etc. including confidence limits.
2. Design a reliability experiment and fit data to a model.
3. Design a statistical manufacturing monitor or control chart with specified producer and customer risk levels.
4. Compute test statistics such coverage, yield, test time, customer defect level from test data

Unit No.	Detail Content	Hrs.
1.	**Quality & statistical process control:** Quality – Definition – Quality Assurance – Variation in process – Factors – process capability – control charts – variables X, R and X, - Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts – charts for variables – Quality rating– Short run SPC.	6
2.	**Acceptance sampling:** Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts – standard sampling plans for AQL and LTPD – use of standard sampling plans.	6
3.	**Experimental design and taguchi method:** Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function – experiments – S/N ratio and performance measure – Orthogonal array.	6
4.	**Concept of reliability:** Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markoveanalysis, load sharing systems, standby systems, covariant models, static models, dynamic models.	6
5.	**Design for reliability and maintainability:** Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress strength and analysis, failure analysis, identification determination of causes,assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time,	6
6.	**Design for maintainability:** Reliability under preventive maintenance state dependent system with repair, MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.	6
	References: - 1 Amata Mitra "Fundamentals of Quality Control and improvement" Pearson Education, 2002. Bester field D.H., "Quality Control" Prentice Hall, 1993. 2 Patrick D.T.O'Connor,Practical Reliability Engineering, John-Wiley and Sons Inc, 2002 4.Charles E Ebling, An Introduction to Reliability and Maintainability Engineering, Tata- McGraw Hill, 2000. 3 David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.	

F. Y.M. Tech. Semester – II
Department of Mechanical Engineering
Institute Elective
IET5201: Computational Techniques in Engineering

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Unit 1: Mathematical Modelling **6 hrs**
Mathematical Modelling and Engineering Problem Solving, Conservation laws and engineering, MATLAB Programming software, Errors

Unit 2: Non-linear Equations **6 hrs**
Newton-Raphson Method, Bracketing Methods, Systems of Nonlinear Equations, Roots of Polynomial Engineering Applications, Ideal and nonideal gas laws, Open channel flow, Design of electric circuit, Vibration Analysis

Unit 3: Linear Simultaneous Equations and Matrices **6 hrs**
Various methods for solving Linear Simultaneous Equations,Numerical methods for various matrix operations. Special matrices, Gauss Seidel, Linear algebraic equations with libraries and packages.

Unit 4: Numerical Integration and Differentiation **6 hrs**
Numerical Differentiation and Integration, Newton-cotes integration formulas, Integration of Equations, Numerical differentiation, Applications-Case studies.

Unit 5: Approximation and Curve Fitting **6 hrs**
Fourier Approximation, Fast Fourier Transform (FFT)- Time domain, Frequency domain,Continuous Fourier series

Unit 6: Initial value & Boundary value Problems in Engineering **6 hrs**

Solution of ordinary differential equations,Partial differential equations, Eigen value Problems, Applications and Case Studies.

References

1. Numerical Methods for Engineers, Chapra Steven and Canale Raymond, Prentice Hall
2. Numerical Methodsin Engineering with Matlab, KiusalaasJaan, Cambridge University Press, 2005
3. Numerical Methods in Engineering with Python, KiusalaasJaan, Cambridge University Press, 2005
4. Numerical Methods for Scientists and Engineers, Richard Wesley Hamming, Dover PubnIncorporated
5. Numerical Methods for Engineers, Gupta Santosh K, New Age International, 1995

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F. Y.M. Tech. Semester – II
Department of MBA
Institute Elective
IET5221: Management For Engineers

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Corse Description:-
Successful researchers in engineering and the life and physical sciences face daily challenges managing and leading teams, communicating with business-oriented colleagues, and surmounting the hurdles associated with the commercialization of research. But engineers in these fields are seldom exposed to these situations before entering academia or industry. To address this gap, The course is designed to provide them with the necessary business and leadership skills.

Prerequisites: -
None

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

5. Lead complex engineering and capital intensive organization with globally dispersed organization structures
6. Solve industry related problems by applying their knowledge of business, science and engineering.
7. Develop and lead effective team and projects
8. Develop and commercialize innovative products.

Unit No.	Detail Content	Hrs.
1	**Strategic Management :** Meaning and importance of Strategic Management , Understanding new perspectives on strategic management Value chain analysis	6
2	**Change Management :** Introduction and importance, Role of team, force field analysis, Adjustment to change and organizing for growth. Prerequisites and consequence of change. The change Dynamics , leading change: why transformational efforts fail	6
3	**Advanced Marketing Management** New product development , trademark and patent , technology transfer , commercialization of research	6
4	**Financial Management :** Break even analysis , leverages, boot strapping, funding (angel and VC) and understanding profit.	6
5	**Customer Relationship Management:** CRM is about Value, Customer Lifetime Value, cross selling, buying behavior , up and down scaling and CRM	6
6	**Business Plan :** Introduction , important components of business plan, market and competition analysis, Designing the plan ,Case studies.	6

References: -

1. John P. Kotter, W. Chan Kim, Renee A. Mauborgne Patrick , Change Management ,Harvard Business Review ,2011
2. Rao A. S. Management of Technology Change– Global Business Press
Narayanan V.K., "Managing Technology and Innovation for competitive Advantage. Pearson: 2001
3. Govindarajan and Chris Trimble, 10 Rules for Strategic Innovations, HBS, 2007.
4. Strategic Management and Business Policy , Thomas Wheelon and David Hunger Prentice Hall; 14 edition ,2014
5. Lawrence G. Hrebiniak , Making strategy work , Wharton, 2005 (Indian Reprint)
6. Value Engineering: A Systematic Approach Arthur E. Mudge - - Mc GrawHill
7. Accelerate: Building Strategic Agility for a Faster-Moving World John P. Kotter,Harvard Business Publishing 2014.

F. Y.M. Tech. Semester – II
Department of MBA
Institute Elective
IET5241: Data Analytics

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Corse Description:-
Data analytics is the science of analyzing the data, generating insights, and making predictions of future events. Data analytics easily finds applications in experimental data analysis, financial modeling, banking industry, market research, operations management, climate modeling, health care management, traffic monitoring, and so on. This course aims to provide an overview of data mining and statistical techniques that arise in real data analytic applications.

Prerequisites: -
Knowledge of basic statistical terms

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

Unit No.	Detail Content	Hrs.
1	**Introduction to Data Analytics :** Meaning and importance of Data Analytics for engineers , Introduction to data mining modeling ,Exploring the data sets, preparation of own datasets , Various types of data analytics models.	6
2	**Introduction to Data Analytics Softwares :** Basic introduction to R - an open source software , SAP , Oracle, SPSS	6
3	**SPSS- Handling and Applications** Handling SPSS, Importing and exporting files, Handling datasets on SPSS, Applications of SPSS in engineering fields.	6
4	**Predictive Modeling** Logistic regression model, applications of logistic regression models; Decision trees models: process of building decision tree, models, model selection.	6
5	**Neural network models** The pros and cons of neural networks, model construction – architecture selection; network training;	6
6	**Hypothesis Testing :** Hypothesis - formulation and types of error, Parametric and non - parametric tests for testing of hypothesis specifically chi-square , ANOVA , Mann- whitney , t-test	6

References: -

1. Andy Field, Research Methodology , Harvard Business r\Press , 2014

F. Y.M. Tech. Semester – II
Department of Mechanical Engineering
Institute Elective
IET5261: Innovation Management

Teaching Scheme				Evaluation Scheme					
L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
					Max	Min for Passing		Max	Min for Passing
3	0	--	3	ISE	20		40	--	--
				MSE	30			--	--
				ESE	50	40		--	--

Course Description:
Economies can only survive in the long term if they have innovative manufacturing and service industries. Increasing the innovative strength of businesses is therefore vitally important for society. Innovation is also essential for companies and their competitive position. Innovation strengthens the loyalty of existing customers and helps to win new customers. The Innovation Management discipline studies the management of innovation processes and develops theories, tools and techniques to make businesses more innovative. Key aspects of this discipline are knowledge management, strategic alliances, new product development, close supplier partnerships, marketing management, quality and reliability engineering, and technology management. The object of the studies is the new product development process and the processes to cooperate with other organizations and share knowledge with them. The aim is to analyze, understand and improve these processes.

Course Learning Outcomes:
1. Recognise the importance of Innovation and the need to view innovation as a management process and appreciate the complex nature of the management of innovation within organisations.
2. Identify the factors organisations have to manage to achieve success in innovation and recognise the relationship between the activities performed and the organisational environment in promoting innovation.
3. Understand organisational knowledge management and the importance of patents/IPR in innovation management. Identify the opportunities for potential Patents, Copyright, trademark.

4. Understand the process of R&D management in modern industries. Recognise the factors influencing open technology & technology transfer, strategic alliances and networks.

Prerequisites:
UG degree with knowledge of Industrial Organisational Management, Engineering Management, Operations management, Product development process, Quality and Reliability Engineering etc.

Unit 1: Innovation and the Market **6 hrs**

Importance of Innovation, Models of innovation, Innovation as a management process, Innovation and the market, diffusion theories.

Unit 2: Innovation and Operations Management **6 hrs**

Operations management, process design and innovation, triggers for innovation, operations and technology concepts

Unit 3: Managing Intellectual property **6 hrs**

Introduction to IPR, Patents – laws, rules and regulations ,filing procedure, infringement, trademark, copyright, use of patents in innovation management

Unit 4: Managing organizational knowledge **6 hrs**

Technology trajectories, knowledge base of an organisation , learning organisation, degree of innovativeness, strategic alliances, forms of strategic alliances, motives risk and limitations, use of alliances in implementing technology transfer.

Unit 5: R&D Management **6 hrs**

R&D management and industrial context, Classifying R&D, Integration of R&D, link with business strategy, strategic pressures, R&D fund management, managing R&D projects, acquisition of external technology, effective R&D management, link with product innovation process, evaluating R&D projects.

Unit 6: Open Innovation and Technology Transfer **6 hrs**

Open innovation – technology, information and knowledge transfer, models of technology transfer, limitations and barriers, inward technology transfer, managing inward transfer of technology, Technology transfer and organizational learning.

References

1. Paul Trott – Innovation management and new product development, Pearson.
2. Tidd, Joe and Bessant, John - Managing Innovation: Integrating Technological, Market and Organizational Change, Wiley publication, 2009.
3. Clark, Charles H. - Idea Management: How to Motivate Creativity and Innovation. New York: AMACOM.

K. E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

(An Autonomous Institute)

Teaching & Evaluation Scheme for

Second Year P.G. Program in Electrical Power System

(To be implemented from Year 2016 - 17)

Semester-III

Course Code	Course	Teaching Scheme				Evaluation Scheme			
		L	T	P	Credits	Scheme	Credits	Practical (Marks) Max	Practical (Marks) Min for Passing
EPS6011	Field Training	--	--	--	2	ISE	2	100	50
EPS6031	Dissertation Stage I	--	--	--	4	ISE	4	100	50
EPS6051	Dissertation Stage II	--	--	5*	10	ISE	4	100	50
EPS6071						ESE	6	100	50
	Total	2		5	16		16		

Total Credits : 18 Total Contact Hours/Week : 5 hrs

Second Year P.G. Program in Electrical Power System
Semester IV

Course Code	Course	Teaching Scheme				Evaluation Scheme			
		L	T	P	Credits	Scheme	Credits	Practical (Marks) Max	Practical (Marks) Min for Passing
EPS6021	Dissertation Stage III	--	--	--	8	ISE	8	100	50
EPS6041	Dissertation Stage IV	--	--	5*	10	ISE	4	100	50
EPS6061						ESE	6	100	50
	Total			5	18				

Total Credits : 18 Total Contact Hours/Week : 5 hrs

ISE : In Semester Evaluation MSE : Mid Semester Examination

ESE : End Semester Examination

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Rajarambapu Institute of Technology Electrical Engg. Department Rajaramnagar

Second Year M. Tech. (Electrical Power System) Semester – III

EPS6011 FIELD TRAINING

Teaching Scheme				Evaluation Scheme				
L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
					Max.	Min. for Passing	Max.	Min. for Passing
--	--	--	2	ISE	--	--	100	50

In the field training work, the student is expected to get training in the industry, related to subject specialization for duration of 15 days (minimum) for at least 6 hrs per day. Student should write a report on the field training and submit to department for ISE evaluation at the beginning of third semester. Student should include the certificate from the company regarding satisfactory completion of the field training.

Second Year M. Tech. (Electrical Power System) Semester – III

EPS6031 DISSERTATION STAGE - I

Teaching Scheme				Evaluation Scheme				
L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
					Max.	Min. for Passing	Max.	Min. for Passing
--	--	--	4	ISE	--	--	100	50

Dissertation Phase-I

It consists of

a) Synopsis Preparation
b) Synopsis approval by DPGC committee

Synopsis Preparation:

Postgraduate student should decide on the dissertation topic in consultation with its supervisor and come out with a synopsis of dissertation work, in July/August of an academic year. The Synopsis shall consist of three chapters - Introduction, Literature Review and Methodology with expected deliverables.

It is expected that student should have in-depth understanding of the selected problem, knowledge of probable solutions to the same problem and expected outcomes from the dissertation work.

The synopsis shall consist of following points

- Title
- Introduction
- Literature Survey
- Objectives
- Methodology
- Activity chart
- References

The title should be brief, accurate, descriptive, comprehensive and clearly indicate the subject for the investigation.

The introduction part should include

1. Area of the work
2. Importance of the work

Literature review should

1. Examine the most current studies on the topic and presenting the significant aspects of these studies.
2. Compare different authors' views about the issue

3. Summarize the literature in terms of a knowledge gap identification e.g. performance improvement of the existing system, functionality improvement of the existing, proposing an entirely new approach, etc.

It should be followed by the Problem statement formulated based on identified gap and objectives of the study

Methodology shall include information such as techniques, sample size, target populations, equipments, data analysis, etc. and explain why proposed methodology is most suitable to solve the undertaken problem.

It should be followed by activity chart mentioning probable duration for completion of various activities to be undertaken during dissertation work and appropriate list of references. The references should be from reputed journals such IEEE, Science direct, and Elsevier etc.

Synopsis approval and evaluation by DPGC Committee:

The student should submit the synopsis duly signed by supervisor in the prescribed format to the department office.

The DPGC committee is advised to conduct the Synopsis Presentation for the students of the program within the stipulated period and give approval to the synopsis with the evaluation score. The committee is advised to find the enough complexity in the dissertation work, and all committee members should remain present at the time of the presentation.

The objective of the presentation is to find quality of work undertaken by the student, student's understanding about basic concepts required to carry out the work, scope of the work , correctness of the methodology, consistency of proposed work with dissertations works of other students and student's ability to communicate his or her ideas and work.

The committee can suggest modifications in the synopsis if it does not fulfill above-mentioned requirements. The student should prepare a modified synopsis by incorporating suggestions given by members and give presentation again.

The supervisor must ensure that student have incorporated all suggestions.

Second Year M. Tech. (Electrical Power System) Semester – III

EPS6051 DISSERTATION STAGE – II

Teaching Scheme				Evaluation Scheme				
L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
					Max.	Min. for Passing	Max.	Min. for Passing
--	--	5*	4	ISE	--	--	100	50

EPS6071 DISSERTATION STAGE – II

Teaching Scheme				Evaluation Scheme				
L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
					Max.	Min. for Passing	Max.	Min. for Passing
--	--	5*	6	ESE	--	--	100	50

Dissertation Phase-II
After synopsis approval, it is expected that student should start working on the selected problem as per activity chart given in the synopsis. It is expected that at least 40% dissertation work should be completed by a student in this phase.

Evaluation of Dissertation Phase-II:
Evaluation (ISE) of Dissertation Phase-II shall be carried before the end of the semester-III and shall be jointly evaluated by Supervisor and Internal-examiner appointed by DPGC committee.

The student should give presentation / demonstration of the work done. The examiners shall look at student's progress and quality of the work done. The suggestions shall be given to the student, if required. The student should keep a record of these suggestions and incorporate them in his or her work. The supervisor should ensure that suggestions given are incorporated by the student.

The End –semester examination (ESE) of Dissertation Phase-II shall be carried out by Controller-of-Examinations after the end of Semester-III. The student should give presentation and/or demonstration of completed work in front of supervisor and external examiner appointed by CoE.

Second Year M. Tech. (Electrical Power System) Semester – IV

EPS6021 DISSERTATION STAGE – III

Teaching Scheme				Evaluation Scheme				
L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
					Max.	Min. for Passing	Max.	Min. for Passing
--	--	--	8	ISE	--	--	100	50

Dissertation Phase-III
In Dissertation Phase-III, it is expected that student should complete at least 70% of the dissertation work and prepare a draft of the paper for publication.

Evaluation of Dissertation Phase-III:
The evaluation (ISE) of Dissertation Phase-III shall be carried out in March of the academic year by Supervisor and Internal examiner appointed by DPGC. The appointed members shall look at student's progress and quality of the work done. The suggestions shall be given to the student, if required. The student should keep a record of these suggestions and incorporate them. The supervisor should ensure that suggestions given are incorporated by the student.

If student's progress is not as per expectation, the committee member shall issue a written notice to the student about probable extension.

Second Year M. Tech. (Electrical Power System) Semester – IV

EPS6041 DISSERTATION STAGE – IV

Teaching Scheme				Evaluation Scheme				
L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
					Max.	Min. for Passing	Max.	Min. for Passing
--	--	5*	4	ISE	--	--	100	50

EPS6061 DISSERTATION STAGE – IV

Teaching Scheme				Evaluation Scheme				
L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
					Max.	Min. for Passing	Max.	Min. for Passing
--	--	5*	6	ESE	--	--	100	50

Dissertation Phase-IV
In Dissertation Phase-IV, it is expected that student should complete

- 100% implementation of the proposed system
- Simulation/ experimentation work on the proposed system
- Performance evaluation of the proposed system
- Comparison of the proposed system with existing systems
- Writing of the conclusion
- Preparation of a draft-copy of the dissertation report with Plagiarism report

Evaluation of Dissertation Phase-IV:
The DPGC committee is advised to evaluate the dissertation pre-submission presentation and/or system demonstration given by the students at the end of semester –IV within the stipulated period and give approval/modifications to the work done by the student along with the evaluation score.

The committee is advised to verify work completion as per the synopsis, and all committee members should remain present for the presentation.

The objective of the presentation/ demonstration is to understand techniques implemented by the student, student's own contribution in the development process, obtained results, comparison of results with existing systems, and deliverables of the dissertation work.

The committee can suggest modifications if it does not fulfill above-mentioned requirements in the system/ draft copy of the report. In this case, the student should modify the system in a given time span based on suggestions given by the members and give presentation again in front of committee members.
The members should ensure that student has incorporated all suggestions and gives him/her approval to submit the dissertation work for final evaluation.

Final evaluation of Dissertation work:
The final evaluation of the dissertation work shall be carried out by a three member committee, comprising of Chairman, External Examiner and concerned supervisor. This committee should be appointed by Controller of Examinations.

The student should give presentation and demonstration of work carried out in front of committee members. The external examiner and supervisor should evaluate student's performance based on following points

1. Justification and clarity of the problem statement and project objectives
2. Use of appropriate, applicable and justifiable methodology to solve problem undertaken
3. Reliability and validity of data collection instruments /resources used, critical data analysis and interpretation
4. Overall system design
5. Experimental Results and their comparison with existing systems
6. Critical analysis of obtained results and their interpretation and correlation with project deliverables
7. Scientific justification of conclusions
8. self contribution of the candidate in project development irrespective of use of readymade hardware/software
9. Presentation skills

The chairman shall ensure smooth conduct of the examination.