Course Curriculum

of

Bachelor of Technology (B.Tech.) Programme

for

Minor

in

Electrical and Electronics Engineering

Department of Electrical and Electronics Engineering
National Institute of Technology Goa
Cuncolim
Goa - 403 703
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Contents

Chapter 1

Semester-wise Credits Distribution

1.1 Credits Distribution

Table 1.1: Semester-wise Credits Distribution for Minor Programme in Electrical Engineering

Sl No	Semester	Course Structure					Total Credit
		Course Code	Course Name	Course Type	L - T - P	Credit	
1	IV	EE250M	Circuit Theory	Core	3-0-0	3	3
2	V	EE300M	Electrical Machines	Core	3-1-0	4	4
3	VI	EE350M	Control System	Core	3-0-0	3	3
4	VII	EE400M	Electrical Power System	Core	3-1-0	4	4
5	VIII	EE450M	Power Electronics	Core	3-1-0	4	4
Total Credits							18

Chapter 2

Course Content : Core Courses

2.1 Circuit Theory

Course Code	Courses Name	Course Type	L - T - P	Credits	Total Hours
EE250M	Circuit Theory	Theory	3 - 0 - 0	3	42

Objectives: To provide tools and concepts for analysing electrical circuits including polyphase systems which will help to understand machines, power systems, and other electrical systems.

Syllabus:

Module 1: Overview of network analysis techniques, Time domain analysis of DC circuits, step response and transients.

Module 2: Sinusoidal Steady State Analysis, AC circuit power analysis, complex power. Polyphase systems: balanced and unbalanced circuits. Analysis of magnetically coupled circuits, mutual inductance, perfectly coupled and ideal transformer.

Module 3: Laplace transform and its properties, solution of differential equations using Laplace transform. Circuit analysis in s - domain : notion of impedance and admittance, Nodal and Mesh analysis, poles, zeros, and transfer function, convolution.

Module 4: Frequency response: series and parallel resonance circuits, high Q circuits. Bode diagram, filter design.

Module 5: Two Port Networks: Z and Y parameters for circuit with dependent sources, Hybrid and Transmission parameters, relationship between parameters, interconnection of two port networks: parallel, series and cascade, applications

Text Books:

1. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "*Engineering Circuit Analysis*," McGraw Hill Education, 6th Edition, 2002.

Reference Books:

1. Richard C. Dorf and James A. Svoboda, "*Introduction to Electric Circuits*," John Wiley & Sons, 6th Edition, 2004.
2. John J. Grainger and William D. Stevenson JR., "*Power System Analysis*," McGraw Hill Education (India) Edition, 2003.
3. DeCarlo and Lin, "*Circuit Theory: Linear Circuit Analysis*," Oxford press, 2nd edition, 2004.

2.2 Electrical Machines

Course Code	Courses Name	Course Type	L - T - P	Credits	Total Hours
EE300M	Electrical Machines	Theory	3 - 1 - 0	4	56

Objectives:

- To provide foundation about few of the basic electrical machines.
- To understand the basics of their operating principles.
- To analysis the functioning and operation of energy conversion systems.

Syllabus:

Module 1: **Basic of Electromagnetism:** Magnetic Fields and the Lorentz Equation, Biot-Savart and Force on a Wire, Ampere's Law, Faraday's Law, Lenz's Law, Induced Electric Field, Inductors, Energy in Inductors. Introduction to rotary machine.

Module 2: **DC Machines:** Construction, classification, emf and torque equation, Types of loads, characteristics of DC motors, Regulation, efficiency, speed control.

Module 3: **Transformers:** Principle, construction (single phase, three phase), equivalent circuit, phasor diagram, regulation, efficiency, autotransformers.

Module 4: **Induction machines:** Principle, construction, classification, equivalent circuit, phasor diagram, characteristics, starting techniques, speed control.

Module 5: **Synchronous machines:** Construction, principle of operation and types, excitation systems, stand alone and grid connected modes of operation, voltage and frequency control.

Module 6: **Special Electrical machines:** Various special types of electrical machines, their working principle and applications.

Text Books:

1. I. J. Nagarath, and D. P. Kothari, "*Electric Machines*" Tata McGraw Hill, 4th Edition, 2010.
2. A. E. Fitzgerald, Charles Kingsley and Stephen D. Umans,"*Electrical Machinery*" 6th Edition, Tata McGraw Hill, 2003.

Reference Books:

1. P. S Bimbhra, "*Electrical Machinery*" 7th Edition, Khanna Publishers, 2008.
2. Clayton and Hancock, "*Performance & Design Of DC Machines*," CBS, 3rd Edition, 2001.
3. Ashfaq Husain, "*Electric machines*," Dhanpat Rai & Company, 2nd Edition, 2002.

2.3 Control Systems

Course Code	Courses Name	Course Type	L - T - P	Credits	Total Hours
EE350M	Control Systems	Theory	3 - 0 - 0	3	42

Objectives: To be familiar with basic control configurations and also to be competent in mathematical modelling of physical systems and analyse their time and frequency response.

Syllabus:

Module 1: **Mathematical Modelling:** Introduction of Open loop and Closed loop systems, Mathematical Modelling of Mechanical, Chemical and Electrical systems: Servo mechanism, synchros, Block diagram and Signal Flow approaches to system representation and Analysis.

Module 2: **Time response Analysis:** Standard test signals, Time response of First and Second order systems, Steady-state Errors and Error constants and Dynamic Error coefficients, Response with P, PI and PID controllers

Module 3: **Concept of stability:** Routh-Hurwitz criterion, root locus, gain margin and phase margin, effect of addition of poles and zeros on root locus.

Module 4: **Frequency domain Analysis:** Frequency response specifications, frequency and time domain correlation, Bode plot, Polar plot, and Nyquist criterion. Compensation Techniques: Design of Lead, Lag, Lead-Lag Compensation.

Module 5: **State Space Analysis:** Concept of state, state variables and state space model, state space representation of continuous-time systems, state equation, solution of state equations, concept of Controllability and Observability

Text Books:

1. Katsuhiko Ogata, "*Modern Control Engineering*", PHI, 5th Edition, 2020.
2. M. Gopal, "*Control Systems, Principles and Design*", Tata McGraw Hill, 2020.

Reference Books:

1. I. J. Nagrath and M. Gopal, "*Control Systems Engineering*", New Age Int., 7th Edition, 2021.
2. Norman S. Nise, "*Control System Engineering*", John Wiley and Sons, Inc, 2018.

2.4 Electrical Power Systems

Course Code	Courses Name	Course Type	L - T - P	Credits	Total Hours
EE400M	Electrical Power Systems	Theory	3 - 1 - 0	4	56

Objectives:

- To understand the Generation, Transmission, Distribution, and Protection of Electrical Power.
- To understand the smart grid operation and control aspects.

Syllabus:

Module 1: **Generation:** Introduction to power system structuring, Present Power Scenario in India, conventional and non-conventional energy sources and their advantages and disadvantages. Architectures of Hydro Electric Generation, Thermal Power Generation, Nuclear Power Generation, Solar Energy and Wind energy.

Module 2: **Transmission:** Short, Medium and Long transmission lines, Regulation and Efficiency, Evaluation of ABCD parameters, Line voltage regulation and compensation. Skin Effect, Proximity Effect, Ferranti Effect and Corona. Line supports, Insulators, sag and tension calculations. Classification of cables.

Module 3: **Distribution:** Comparison of various distribution systems and General aspects, AC and DC distributions, Techniques of Voltage Control and Power Factor Improvement, Distribution Loss, Types of distribution Substations.

Module 4: **Protection:** Introduction to Power System Protection, Circuit Breaker: Rating, types. Types of Relays, Few Protection Schemes, Grounding Methods.

Module 5: **Smart Electric Grid:** Evolution of Smart Grid, advantages, Indian smart grid journey, Pilot and Smart Grid Projects, key challenges for smart grids, Distribution Automation, Supervisory Control and Data Acquisition, Distributed Generation, Energy Storage systems.

Text Books:

1. C. L. Wadhwa, "*Electrical Power Systems,*" New Age Int. Publishers, 2022.

2. D. P. Kothari and I. J. Nagrath, "*Power System Engineering,*" Tata Mcgraw-Hill, 3rd Edition, 2019.

Reference Books:

1. Sunil S. Rao, "*Switch gear and protection,*" Khanna publishers, 1997.

2. Soni, Gupta, Bhatnagar and Chakrabarti, "*A text book on Power Systems Engineering,*" Dhanpat Rai and Sons, New Delhi, 2016.

3. G. D. Rai, "*Non-conventional Energy Sources*", Khanna Publishers, New Delhi, 2022.

2.5 Power Electronics

Course Code	Courses Name	Course Type	L - T - P	Credits	Total Hours
EE450M	Power Electronics	Theory	3 - 1 - 0	4	56

Objectives: To introduce characteristics of power electronic components, design of various power converter circuits and their applications.

Syllabus:

Module 1: **Power Electronics Components:** Principle of operation, characteristics, ratings, protection, overview of gate drive circuits, loss calculations.

Module 2: **DC-DC Converter:** Principle of operation, classifications, Analysis and Applications.

Module 3: **DC-AC Converter:** Principle of operation, classifications, Analysis and Applications.

Module 4: **AC-AC Converter:** Principle of operation, classifications, Analysis and Applications.

Module 5: **AC-DC Converter:** Principle of operation, classifications, Analysis and Applications.

Module 6: **Applications:** Few applications of Power electronic Systems.

Text Books:

1. Ned Mohan, Undeland and P Robin, "*Power Electronics Converters, Applications and Design*", John Wiley & Sons, 3rd Edition, 2007
2. M. H. Rashid, "*Power Electronics - Circuits, Devices and Applications*", PHI, 3rd Edition, 2003.

Reference Books:

1. P. S. Bhimbra, "*Power Electronics*", Khanna Publishers, 4th Edition, 2010.

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