Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electrical Engineering

(Applicable from the academic session 2018-2019)

Semester-VII

Name of the course		**ELECTRIC DRIVE**	
Course Code: PC-EE 701		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand basic concept, classification and principle of operation of Electric Drive.		
2.	To understand methods of starting and braking of Electric Drive.		
3.	To understand methods of control of speed of DC and AC Drives.		
4.	To solve problem related to Electric Drive.		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Machine-I (PC-EE-401)		
3.	Electric Machine-II(PC-EE-501)		
Unit	Content	Hrs	Marks
1	**Electric Drive:** Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multi-quadrant operation of drives. Load equalization.	5	
2	**Motor power rating:** Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors.	5	
3	**Stating of Electric Drives:** Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time, Energy relation during stating. Methods to reduce the Energy loss during starting. **Braking of Electric Drives:** Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking,	6	
4	**DC motor drives:** Modeling of DC motors**,** State space modeling, block diagram & Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor	8	

	current. Chopper controlled DC motor drives. Closed loop control of DC Drives.		
5	**Induction motor drives:** Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.	6	
6	**Synchronous motor drives:** Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector control.	5	
7	Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive **Industrial application:** Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.	5	

Text books:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. Electric Drives, Vedam Subrahmanyam, TMH
3. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication.

Reference books:

1. Electric motor drives, R. Krishnan, PHI
2. Modern Power Electronics & Ac drives, B.K. Bose, Pearson Education.
3. Electric Motor & Drives. Austin Hughes, Newnes.

Course Outcome: After completion of this course, the learners will be able to

1. explain the principle of operation of Electric Drive.
2. describe different methods of starting and braking of Electric Drive.
3. model and control DC Drive
4. control speed of Induction and Synchronous motors.
5. recommend drives for different applications.
6. estimate ratings, variables and parameters of Electric Drives.

Special Remarks (if any)

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course		**CONTROL SYSTEM DESIGN**	
Course Code: PE-EE 701 A		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand basic design specifications.		
2.	To understand design of control system in time domain, frequency domain and in State space.		
3.	To understand design of PID controllers		
4.	To solve problem related to design of control system.		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Control system (PC-EE-503)		
Unit	Content	Hrs	Marks
1	**Design Specifications:** Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.	6	
2	**Design of Classical Control System in the time domain:** Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.	8	
3	**Design of Classical Control System in frequency domain:** Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.	8	
4	**Design of PID controllers:** Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.	6	
5	**Control System Design in state space:** Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle.	8	
6	**Nonlinearities and its effect on system performance:** Various types of non-linearities. Effect of various non-linearities on system	4	

	performance. Singular points. Phase plot analysis.		

Text books:

1. Control System Engineering, N. Nise, 8th Edition, John Wiley, 2019.
2. Control System Engineering, , I. J. Nagrath and M. Gopal, New Age International Publishers, 2018.
3. Design of Feedback Control Systems, R.T. Stefani and G.H. Hostetter , Saunders College Pub, 1994.
4. Linear control system analysis and design (conventional and modern), John J .D'azzo, C.H. Houpis, McGraw Hill, 1995.

Reference books:

1. Digital Control Engineering, M. Gopal , New Age International Publishers, 2014.
2. Automatic Control system, B. C. Kuo, F. Golnaraghi, Wiley, 2014.
3. Modern Control Engineering, K. Ogata, 5th Edition, Prentice Hall, 2010.

Course Outcome: After completion of this course, the learners will be able to

1. explain the effect of gain, addition of pole and zeros on system's performance.
2. describe time domain and frequency domain design specifications.
3. demonstrate the effect of nonlinearity on system performance.
4. design control system in time domain , in frequency domain and in state space.
5. design PID controllers.
6. select appropriate method for design of control system.

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Special Remarks (if any)

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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Syllabus for B. Tech in Electrical Engineering

(Applicable from the academic session 2018-2019)

Name of the course		**ELECTRICAL ENERGY CONSERVATION & AUDITING**	
Course Code: PE-EE 701B		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the basic of energy resources, energy security, energy conservation and pollution.		
2.	To understand the energy management concepts.		
3.	To understand energy conservation principles and measures		
4.	To learn the methods of energy audit and usage of instruments		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Machine (PC-EE-401, PC-EE-501)		
3.	Electric Power system (PC-EE-502, PC-EE-601)		
4.	Control System (PC-EE-503)		
Unit	Content	Hrs	Marks
1	**Energy Scenario:** Commercial and Non-commercial energy, Primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.	5	
2	**Basics of Thermal Energy management :** Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.	5	
3	**Energy Management & Audit:** Definition, energy audit, need, types of energy audit. Energy management (audit) approach, understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.	6	
4	**Energy Efficiency in Electrical Systems:** Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Performance	8	

	assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.		
5	**Energy Efficiency in Industrial Systems:** Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.	10	
6	**Energy Efficient Technologies in Electrical Systems:** Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.	6	

Text books:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. Electric Energy Utilization and Conservation, S. C. Tripathy, Tata McGraw Hill, 1991.

Reference books:

1. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Course Outcome: After completion of this course, the learners will be able to

1. explain the basic of energy resources, energy security, energy conservation and pollution.
2. quantify the energy conservation opportunities in different thermal systems
3. quantify the energy conservation opportunities in different electrical systems
4. identify the common energy conservation opportunities in different energy intensive industrial equipments
5. explain the methods of energy management and audit.
6. analyse and report the outcome of energy audit.

Special Remarks (if any) The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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Name of the course		**POWER GENERATION ECONOMICS**	
Course Code: PE-EE 701C		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the basics of economics of Power generation.		
2.	To understand different methods of Tariff.		
3.	To understand the optimization with unit commitment in power system.		
4.	To understand the principle of economic load dispatch.		
5.	To understand the method of state estimation and load forecasting in a power system.		
Pre-Requisite			
1.	Electric Power system-I (PC-EE-502)		
2.	Electric Power system-II (PC-EE-601)		
Unit	Content	Hrs	Marks
1	**Economics of Generation:** Cost of power generation- Thermal, Hydro and Nuclear. Types of Consumers in a distribution system- Domestic, Commercial, Industrial etc. Concept of load factor, plant capacity factor, plant use factor, diversity factor, demand factor. Choice of size and number of generation units.	07	
2	**Tariff:** Block rate, flat rate, two part, maximum demand, Power factor and three part tariffs. Subsidization and Cross subsidization. Availability tariff of generation companies. Pool tariff of transmission companies. Availability based tariff (ABT).	08	
3	**Unit Commitment:** Constraints in Unit Commitment, Spinning reserve, Thermal unit constraints, Hydro constraints, Must run, Fuel constraints. Unit commitment solution methods,	07	
4	**Economic Dispatch**: Transmission loss formulae and its application in economic load scheduling. Computational methods in economic load scheduling. Active and reactive power optimization	08	
5	**State Estimation and load forecasting in power system:** Introduction, state estimation methods, concept of load forecasting, load forecasting technique and application in power system.	08	

Text books:

1. Economic operation of Power System, L.K. Kirchmayar Wiely India Pvt. Ltd, 2009
2. Power system Analysis, operation & control, A. Chakrabarty & S. Haldar, PHI, 2010.
3. Modern power system analysis, D.P. Kothari & I.J. Nagtrath, Tata McGraw Hill, 2007.

Reference books:

1. Power generation operation & control, A.J. Wood & B.F. Wollenberg, G.B. Sheble, Wiley, 2013
2. Operation and control in power system, P.S.R. Murthy, BSP Publication. 2009

Course Outcome: After completion of this course, the learners will be able to

1. explain the different terms e.g. load factor etc for economics of generation.
2. apply different types of tariff for electricity pricing.
3. optimize the operation of power system with unit commitment.
4. determine generation levels such that the total cost of generation becomes minimum for a defined level of load.
5. determine the state of the system given by the voltage magnitudes and phase angles at all buses,
6. predict the power or energy needed to balance the supply and load demand at all the times.

Special Remarks (if any)

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(Applicable from the academic session 2018-2019)

Name of the course	**ARTIFICIAL INTELLIGENCE**
Course Code: OE-EE-701A	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand the basic concepts, theories and state-of-the-art techniques of artificial intelligence.
2.	To understand basic concepts and applications of machine learning.
3.	To learn the application of machine learning /A.I algorithms in the different fields of science, medicine, finance etc.
Pre-Requisite	
1.	Programming for problem solving (ES-CS201)
2.	Mathematics (BS-M301)
3.	Data structure and algorithm(OE-EE-501A)

Unit	Content	Hrs	Marks
1	**Introduction:** Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. **Intelligent Agents**: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. **Problem Solving:** Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	06	
2	**Search techniques**: Solving problems by Searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. **Heuristic search strategies:** Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. **Adversarial search :** Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening	12	
3	**Knowledge & reasoning:** Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation	05	

4.	**Using predicate logic:** Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Probabilistic reasoning [4] Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logic	06	
5.	**Natural Language processing:** Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing. **Learning:** Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. **Expert Systems:** Representing and using domain knowledge, expert system shells, knowledge acquisition	08	

Text book:

1. Artificial Intelligence, K, Knight, E. Rich, S.B. Nair, 3rd Edition TMH
2. A classical approach to Artificial Intelligence, M.C. Trivedi, 2nd Edition, Khanna Publishing House, New Delhi
3. Introduction to Artificial Intelligence & Expert Systems, D.W. Patterson, PHI
4. Artificial Intelligence A Modern Approach, Stuart Russel, Peter Norvig, Pearson

Reference books

1. Computational Intelligence, D. Poole, Alan Mackworth, and Randy Goebe, lOUP
2. Logic & Prolog Programming, Saroj Kaushik, New Age International
3. Expert Systems principle and programming, J.C. Giarranto, Cengage Learing.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the concept of knowledge representation and predicate logic and transform the real life information in different representation
2. describe state space and its searching strategies
3. demonstrate profciency in applying scientifc method to models of machine learning
4. apply the machine learning concepts in real life problems
5. demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**INTERNET OF THINGS**
Course Code: OE-EE-701B	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand the terminology, technology and its applications
2.	To understand the concept of M2M (machine to machine) with necessary protocols
3.	To learn the Python Scripting Language which is used in many IoT devices.
4.	To understand the Raspberry PI platform, that is widely used in IoT applications.
5.	To understand the implementation of web based services on IoT devices.
Pre-Requisite	
1.	Programming for problem solving (ES-CS201)

Unit	Content	Hrs	Marks
1	**Introduction to Internet of Things:** Definition and characteristics of IoT, Physical design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs, IoT enabled technologies – Wireless sensor networks, Cloud computing, Big data analytics, Communication protocols, Embedded systems, IoT levels and templates, Domain specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.	08	
2	**IoT and M2M:** Software defined networks, network function virtualization, difference between SDN and NFV for IoT. Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER	06	
3	**Introduction to Python:** Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling. Python packages - JSON, XML, HTTP Lib, URL Lib, SMTP Lib.	08	
4.	**IoT Physical Devices and Endpoints:** Introduction to Raspberry PI - Interfaces (serial, SPI, I2C). Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.	08	
5.	**IoT Physical Servers and Cloud Offerings:** Introduction to Cloud Storage models and communication APIs. Webserver – Web server for IoT, Cloud for IoT, Python web application framework. Designing a RESTful web API	08	

Text book:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2016.
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things**,** David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Pearson Education, 2017.
4. Internet of Things, K.G. Srinivasa , G.M. Siddesh, R.R. Hanumantha, CENGAGE Leaning India, 2018

Reference books:

1. Internet of Things (A Hands-on-Approach), Arshdeep Bahga and Vijay Madisetti, VPT, 2014.
2. Internet of Things: Architecture and Design Principles, Raj Kamal , McGraw Hill Education, 2017.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the definition and usage of the term “Internet of Things” in different contexts
2. explain the key components that make up an IoT system.
3. differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack
4. build and test a IoT system involving prototyping, programming and data analysis
5. apply cloud computing and data analytics in a typical IoT system

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course		**COMPUTER GRAPHICS**	
Course Code: OE-EE-701C		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand fundamental concepts and theory of computer graphics		
2.	To understand the concept of graphics systems, input devices, geometric representations, 2D/3D transformations, viewing and projections and visible surface detection.		
Pre-Requisite			
1.	Programming for problem solving (ES-CS201)		
2.	Mathematics (BS-M301)		
3.	Data structure and algorithm(OE-EE-501A)		
Unit	Content	Hrs	Marks
1	**Introduction to Computer graphics & graphic systems:** Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.	06	
2	**Scan conversion:** Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.	05	
3	**2D Transformations and viewing:** Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method **3D transformation & viewing:** 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing	12	
4	**Plane Curves and Surfaces:** Curve Representation, Nonparametric Curves, Parametric Curves, Parametric Representation of a Circle, Parametric Representation of an Ellipse, Parametric Representation	06	

	of a Parabola, Parametric Representation of a Hyperbola, A Procedure for using Conic Sections, The General Conic Equation; Representation of Space Curves, Cubic Splines, , Bezier Curves, B-spline Curves, B-spline Curve Fit, B-spline Curve Subdivision, Parametric Cubic Curves, Quadric Surfaces. Bezier Surfaces		
5	**Visible-Surface Determination:** Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painter's algorithms (depth sorting), Area sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison of the methods.	06	
6	**Color & shading models :** Light & color model; interpolative shading model; Texture. **Introduction to Ray-tracing:** Human vision and color, Lighting, Reflection and transmission models	05	

Text book:

1. Computer Graphics (C version), Hearn, Baker, Pearson Education, 2002
2. Schaum's outlines Computer Graphics , Z. Xiang, R. Plastock , McGraw Hill Education, 2000.
3. Mathematical Elements for Computer Graphics, D. F. Rogers, J. A. Adams, McGraw Hill Education, 2017.

Reference books:

1. Computer Graphics, Multimedia and Animation, M.K. Pakhira, PHI, 2010.

Course Outcome:

After completion of this course, the learners will be able to

1. explain Computer graphics and graphic systems.
2. test and implement line drawing algorithm, circle and ellipse drawing algorithm, area filling algorithms.
3. Perform 2D and 3D transformation and viewing.
4. apply algorithms for visible surface determination.
5. explain colors and shading models and ray tracing.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**EMBEDDED SYSTEM**
Course Code: OE-EE 702A	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand fundamental concepts of design principles of embedded system.
2.	To understand the role of firmware, operating systems in correlation with hardware systems.
Pre-Requisite	
1.	Programming for problem solving (ES-CS 201)
2.	Micro processor & Micro controller (PC-EE 602)

Unit	Content	Hrs	Marks
1	**Introduction to Embedded Systems:** Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	05	
2	**Typical Embedded System:** Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Interfacing techniques, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.	07	
3	**Advanced Embedded Microcontrollers:** PIC Microcontrollers: Overview and features; PIC 16C6X/7X - File Selection Register (FSR), PIC Reset Actions, PIC Oscillator connections, PIC Memory Organization, PIC 16C6X/7X instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, Timers. PIC 16F8XX Flash Microcontroller – Introduction, Pin diagram, Registers, Memory organization, Interrupts, I/O Ports, Timers. Introduction to AVR microcontroller: Introduction to AVR (ATmega 328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register, Port Registers (PORTx), PWM registers (8-bit), ADC registers. Introduction to ARM microcontroller: Architecture of ARM Embedded microcontroller, ARM instruction sets.	12	
4	**Embedded Firmware:** Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.	06	
5	**RTOS Based Embedded System Design:** Operating System	10	

	Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.		

Text book:

1. Introduction to Embedded Systems, Shibu K.V, Mc Graw Hill. 2017

Reference books:

1. Embedded Systems – Architecture, Programming and design, Raj Kamal, McGraw Hill Education, 2017
2. Embedded System Design: A unified Hardware/ Software introduction, Tony Givargis and Frank Vahid, Wiley 2006
3. Design with PIC Microcontrollers , J. B. Peatman, Pearson India,2008
4. Microcontrollers (Theory and Applications) – A. V. Deshmukh, TMH Education Private Limited, 2017
5. Programming and Customizing the AVR Microcontroller, Dhananjay Gadre, McGraw Hill Education, 2014.

Course Outcome:

After completion of this course, the learners will be able to

1. discuss the definition, purpose, application, classification , quality characteristics and attributes of Embedded Systems
2. explain the internal structure of the Embedded system.
3. interface IO devices and other peripherals with micro controllers in Embedded systems.
4. write programs for Micro controllers in Embedded systems.
5. apply the concept of Embedded firmware in design of Embedded systems.
6. design RTOS based Embedded systems.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electrical Engineering

(Applicable from the academic session 2018-2019)

Name of the course	**DIGITAL IMAGE PROCESSING**
Course Code: OE-EE 702B	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand fundamentals and mathematical transforms necessary for image processing.
2.	To understand the image enhancement techniques.
3.	To understand the image restoration procedures.
4.	To understand the image compression procedures.
Pre-Requisite	
1.	Digital Signal Processing (OE-EE 601A)

Unit	Content	Hrs	Marks
1	**Introduction:** Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relationships Between Pixels- Neighbors and Connectivity of pixels in image, Applications of Image Processing: Medical imaging, Robot vision, Character recognition, Remote Sensing.	08	
2	**Image Enhancement In The Spatial Domain**: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.	08	
3	**Image Enhancement In Frequency Domain:** Introduction, Fourier Transform, Discrete Fourier Transform (DFT), properties of DFT, Discrete Cosine Transform (DCT), Image filtering in frequency domain.	08	
4	**Image Segmentation:** Introduction, Detection of isolated points, line detection, Edge detection, Edge linking, Region based segmentation- Region growing, split and merge technique, local processing, regional processing, Hough transform, Segmentation using Threshold.	08	
5	**Image Compression:** Introduction, coding Redundancy , Inter-pixel redundancy, image compression model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking, DCT implementation using FFT, Run length coding.	08	

Text book:

1. Digital Image Processing, R.C Gonzalez and R. Woods, Pearson publication, 2017
2. Digital Image Processing, Anil K. Jain, Prentice-Hall, India, 1988.

Reference books:

1. Digital Image Processing, W.K. Pratt , John Wiley & Sons, 1991.
2. Digital Image Processing and Analysis, B. Chanda & D. Dutta Majumder Prentice-Hall India, 2011
3. Image Processing- Theory, Algorithms & Architecture, M. A. Sid-Ahmed, McGraw-Hill, 1994.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the fundamental concepts of a digital image processing system.
2. enhance images in the spatial and frequency domain using various transforms.
3. apply different image segmentation techniques.
4. categorize various compression techniques.
5. implement image process and analysis algorithms.
6. apply image processing algorithms in practical applications.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**COMPUTER NETWORK**
Course Code: OE-EE 702C	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand the fundamental concepts of data communication and computer networking.
2.	To understand different layers of OSI, TCP/IP model in networking.
Pre-Requisite	
1.	Data Structure and Algorithm (OE-EE 501A)
2.	Operating System

Unit	Content	Hrs	Marks
1	**Overview of Data Communication and Networking:** Introduction, Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.	06	
2	**Physical Level:** Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit Switching: time division & space division switch, TDM bus; Telephone Network.	04	
3	**Data link Layer:** Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, HDLC. **Medium Access sub layer:** Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (in brief).	10	
4	**Network layer:** Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : IP addressing, sub netting; Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, IP, ICMP, IPV6. **Transport layer:** Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm	12	

5	**Application Layer:** Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls. **Modern topics:** ISDN services & ATM, DSL technology, Cable Modem: Architecture and operation in brief. Wireless LAN: IEEE 802.11, Introduction to blue-tooth.**:**	08	

Text book:

1. Data Communications and Networking , A. Forouzan , TMH, 2004
2. Computer Networks , A. S. Tanenbaum, Pearson Education, 2003.
3. Data and Computer Communications (5th Ed.), W. Stallings, Pearson Education, 2017.

Reference books:

1. Communication Networks, Leon, Garica, Widjaja, McGraw Hill, 2017.
2. High performance Communication Networks, Walrand, Elsvier India, 2004.
3. Internetworking with TCP/IP, vol. 1, 2, 3, Comer, Pearson Education, 2000.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the concepts of data communication and networking.
2. identify the different types of network topologies and protocols.
3. describe the function of a network system with OSI and TCP/IP model.
4. differentiate different types of routing protocol.
5. apply principles of congestion control .
6. implement different schemes for security of the networks.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course		**PRINCIPLE OF MANAGEMEENT**	
Course Code: HM-EE 701		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand basic concept and approaches to management.		
2.	To understand planning and decision making processes. .		
3.	To understand organizational design and structure.		
4.	To understand various aspects of leadership.		
Pre-Requisite			
1.	English (HM- HU 201)		
Unit	Content	Hrs	Marks
1	**Concept & approaches to management:** Meaning & Definition of the term Management, Management as a Science or an Art, Management as a Profession, Management as a Process, Difference between Management & Administration; Levels of Management, Roles of a Manager, Quality of a good Manager, Significance of Management, Limitations of Management, Business Environment and its interaction with Management. Approaches to Management – Classical, Neo-classical and Modern Contributors to Management Thought – Taylor and Scientific Theory, Fayol's and Administrative Theory, Peter Drucker and Management Thought. Various Approaches to Management (i.e. Schools of Management Thought) Indian Management Thought	8	
2	**Planning & decision making:** Planning: Meaning, Definition, Process, Types, Principles, Significance & Limitations of Planning; Strategic Planning – Meaning & Process, MBO – Meaning, Process and Requirements for Implementation, Planning Premises – Meaning & Types, Forecasting – Meaning & Techniques. Decision Making – Meaning, Types, Process, Significance & Limitations	8	
3	**Organization design & Structure:** Organization – Meaning, Process, Principles, Organization Structure – Determinants and Forms: Line, Functional, Line & Staff, Project, Matrix and Committees; Formal and Informal Organization; Departmentation – Meaning and Bases; Span of Control – Meaning and Factors Influencing; Authority, Responsibility and Accountability; Delegation – Meaning, Process; Principles; Centralization and Decentralization – Meaning; Degree	8	

	of Decentralization; Difference between Delegation and Decentralization.		
4	**Directing:** Motivation – Meaning , Definition, Significance & Limitations; Financial and non-financial incentives of Motivation Leadership - Meaning, Definition, Significance of Leadership, Leadership styles Type, Process and Barriers of Communication, Strategies to overcome the Barriers.	8	
5	**Customer Management** – Market Planning & Research, Marketing Mix, Advertising & Brand Management. **Operations & Technology Management** – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.	8	

Text books:

1. Essentials of Management. H. Koontz and H. Weihrich , 7th Edition, Tata McGraw Hill
2. Principles of Management, Premvir Kapoor, Khanna Publishing House, 2019
3. Principles of Management - Text and Cases, Dipak Kumar Bhattacharyya. Pearson Education India, 2011.

Reference books:

1. Management-Text & Cases, V.S.P Rao & Hari V. Krishna, Excel Books, 2005
2. Principles of Management, T. Ramaswami, Himalaya Publishing House, 2014
3. Management of Technology and Operations, R. Ray Gehani, Wiley, 1998

Course Outcome: After completion of this course, the learners will be able to

1. explain the concepts and approaches of management.
2. demonstrate the roles, skills and functions of management.
3. diagnose and solve organizational problems.
4. identify the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.
5. apply different methods of Customer, Operation and Technology management.
6. acquire skills of good leader in an organization.

Special Remarks (if any)

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**ELECTRIC DRIVE LABORATORY**
Course Code: PC-EE 791	**Semester: 7th**
Duration: 6 months	**Maximum marks:100**
Teaching Scheme	**Examination scheme:**
Theory: 0 hr/week	**Continuous Internal Assessment:40**
Tutorial: 0 hr/week	**External Assessment: 60**
Practical: 2 hrs/week	
Credit Points:1	

	Laboratory Experiments:
1.	Study of speed control of Thysistor controlled DC Drive.
2.	Study of speed control of Chopper fed DC Drive
3.	Study of speed control of single phase motor using TRIAC.
4.	Study of PWM Inverter fed 3 phase Induction Motor control using software.
5.	Study of VSI / CSI fed Induction motor Drive using software.
6.	Study of V/f control of 3phase Induction motor drive.
7.	Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software.
8.	Study of Regenerative / Dynamic braking operation for DC Motor - Study using software.
9.	Study of Regenerative / Dynamic braking operation of AC motor - study using software.
10.	Study of PC/PLC based AC/DC motor control operation.

Institute may develop experiments based on the theory taught in addition to experiments mentioned.

Course outcome: After completion of this course, the learners will be able to

1. identify appropriate equipment and instruments for the experiment.
2. test the instrument for application to the experiment.
3. construct circuits with appropriate instruments and safety precautions.
4. apply different methods of control of Electric Drive in the laboratory.
5. analyse experimental data obtained in the laboratory.
6. work effectively in a team

Special Remarks: The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.