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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	MST EXAM	QUIZ/ ASSIGNMENT	END SEM	LAB WORK				
BTME701	DCS	AUTOMOBILE ENGINEERING	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Quiz/ Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

To knowledge of (A) chassis layout, suspension system, braking system, (B) wheel and tyres, frame and body, transmission, steering system, (C) ignition system, automotive air conditioning & automotive safety is imparted in this subject.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Student would be able to understand the need of automobile in society.
2. Student would be able to analyses basics of automobile and able to understand various applications.
3. Students would be able to understand wheels, Tyres, steering system & suspension system
4. Students will be able to understand the basics of gearbox, drives.
5. Student would be able to understand automobile safety and their need.
6. Students would be able to understand clutches, brakes and ignition system.
7. Students would be able to understand automotive air conditioning & automotive safety

Syllabus

Unit-1

Frame, Body, Clutches, & Brakes: Layout of chassis, types of chassis frames and bodies, their constructional features and materials. Single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. Classification and function; Mechanical, hydraulic, vacuum air and self-engineering brakes; Brake shoes and lining materials.

Unit-II

Gear Boxes, Drives: Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter overdrive, Propeller shaft, Universal

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joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and all-wheel drive.

Unit-III

Wheels, Tyres, Steering system & Suspension system: Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre, steering gear boxes, Steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types. Objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system Shock absorbers.

Unit:-IV

Automotive Electrical System & Ignition System: Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification. Magneto and coil ignition systems, System components and requirements, automotive lighting: Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator.

UNIT:-V

Automotive Air Conditioning & Automotive Safety: Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis. Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System)

Text Book:

1. *"A Course in Automobile Engineering", by RP SHARMA, ,Dhanpat Rai & Sons*
2. *"A Text book of Automobile Engineering",byP S Gill, KATSON Books VOL 1&2 2010*
3. *"Automobile Engineering", by Kirpal Singh, , Standard 2003*

Reference Books:

1. *"A Text book of Automobile Engineering", by R K Rajpoot, ,Laxmi Publications 2007*
2. *"The Automotive Chassis: Engineering Principles", by Jornsen Reimpell, Helmut Stoll, Jurgen Betzler (P) Ltd 2001*

List of Experiments:

1. Valve refacing and valve seat grinding and checking for leakage of valves
2. Trouble shooting in cooling system of an automotive vehicle
3. Trouble shooting in the ignition system, setting of contact breaker points and spark plug gap
4. Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.

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5. Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.
6. Fault diagnosis in transmission system including clutches, gear box assembly and differential.
7. Replacing of ring and studying the method of replacing piston after repair.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME712	DES	POWER PLANT ENGINEERING	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

(A) This course on Power Plant Engineering covers the various methods of converting various source of energy into electric energy (electric power) and thermodynamics analysis of their working cycle, and how to handle other component of power plant (B) This course shall be very helpful to the engineering student to develop essential skill & knowledge of the Power Plant Engineering in demand.

Course Outcomes (COs):

After learning the course the students should be able to:

1. Understand the different power generation methods, its economics and global energy situation.
2. Apply the basic thermodynamics and fluid flow principles to different power generation methods.
3. Analyze thermodynamic cycles of steam power plant and understand construction, working and significance of its various systems.
4. Analyze thermodynamic cycles of gas turbine power plant, nuclear power plant and jet propulsion systems.
5. Perform the preliminary design/analysis of the major components or systems of a conventional or alternative energy power plant.
6. Calculate the performance of gas turbines with reheat and regeneration, and discuss the benefit of combined cycle power plants.

Syllabus

Unit-I

Introduction: Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

Unit-II

Steam Power Plant: Layout, site selection, coal burning methods, disposal of ash and dust,

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combined cycle power plants, integrated coal gasification, major plant components: condensers, cooling towers.

Nuclear Power Plant: Location, component of nuclear plants, types of reactors, Uranium enrichment, safety, disposal of nuclear waste, comparison with thermal plants.

Unit-III

Hydro Electric Power Plant: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and pico hydro machines, selection of hydraulic turbines for power stations, selection of site.

Unit-IV

Coal and Ash Handling System: Coal storage, Burning systems, Types of stokers and their working, Pulverized fuel handling systems, Unit and central systems, Pulverized mills- ball mill, Bowl mill, Ball & race mill, Impact or hammer mill, Pulverized coal burners, Oil burners, Necessity of ash disposal, mechanical; hydraulic; pneumatic and steam jet ash handling system, Dust collection and its disposal, Mechanical dust collector, Electrostatic precipitator. **Feed Water Treatment**: Necessity of feed water treatment, Different impurities found in feed water, Effect of impurities, pH & its role in corrosion and scale formation, Internal & external water treatment systems – Hot lime soda process, Zeolite ion exchange process, Demineralization plants, Reverse osmosis process, Sea water treatment using reverse osmosis, De-aeration

Unit-V

Economics of Power Generation: Load curves, Load duration curves, Connected load, Maximum load, Peak load, Base load and peak load power plants, Load factor, Plant capacity factor, Plant use factor, Demand factor, Diversity factor, Cost of power plant, Performance and operating characteristics of power plant, Tariff for electric energy.

Reference Books:

1. *"Power Plant Engineering" by M. K. Gupta, PHI Learning Pvt. Ltd.*
2. *"Power Plant Engineering" by P.K. Nag, McGraw-Hill Education.*
3. *"Thermal Engineering" by R.K. Rajput, McGraw-Hill Education.*
4. *"Power Plant Engineering", by V.M. Domkundwar , Dhanpath Rai & Co.*
5. *"Power Plant Engineering", by C.P. Sharma, Katharia and Sons.*
6. *"Steam and Gas Turbine", by R. Yadav, Central Publishing House Allahabad.*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME722	DES	RENEWABLE ENERGY	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

To introduction with (a) Solar Energy (b) Wind Energy (c) Bio Energy (d) Ocean Energy & Geothermal Energy.

Course Outcomes (COs):

After learning the course the students should be able to:

1. Understand the basic concept of renewable energy engineering.
2. Acknowledge, access and analysis various renewable energy system & technology.
3. Evaluate renewable energy related system for a particular application.
4. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Syllabus

Unit – I

Introduction: Needs of Renewable Energy, Advantages and Limitations of Renewable Energy, Present energy scenario of conventional and renewable energy sources, Review of energy sources ,Present energy consumption /Utilisation pattern sector wise in India ,Environmental impact of fossil fuels, growth of energy sector and its planning in India.

Unit – II

Solar Energy: Solar radiation at the earth's surface, solar radiation measurements, estimation of average solar radiation, solar thermal flat plate collectors, concentrating collectors, solar thermal applications; heating, cooling, desalination, drying, cooking, etc, principle of photovoltaic conversion of solar energy, photovoltaic applications. Photovoltaic system for power generation, solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages

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Unit – III

Wind Energy: Power in the wind, Betz limit, site selection, wind energy conversion devices, characteristics, applications, offshore wind energy, Hybrid systems, safety and environmental aspects, wind energy potential and installation in India. basics of wind energy conversion system, effect of density, angle of attack and wind speed, windmill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind.

Unit - IV

Bio-Energy: Biomass resources and their classification, biomass conversion processes, thermo chemical conversion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, alcohol production from biomass, bio diesel production, urban waste to energy conversion, biomass energy programs in India.

Unit-V

Ocean Energy: OTEC principle, open, closed and hybrid cycle OTEC system, Energy from tides, estimation of tidal power, tidal power plants, single and double basin plants, site requirements, advantages and limitations wave energy, wave energy conversion devices, advantages and disadvantages, ocean thermal energy.

Geothermal energy: Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications

MHD Power generation: concept and working principle

Reference Books:

1. *"Solar Energy: Principles of Thermal Collection and Storage", by S. P. Sukhatme and J. K. Nayak, McGraw-Hill Education (1996).*
2. *"Solar Engineering of Thermal Processes", by John A. Duffie, William A. Beckman, John Wiley, New York (2013).*
3. *"Non-conventional energy resources", by Shobh Nath Singh, Pearson India (2015).*
4. *"Solar Energy Engineering", by Soteris Kalogirou, Elsevier/Academic Press (2009).*
5. *"Principles of Solar Energy", by Frank Krieth & John F Kreider, John Wiley, New York (2015).*
6. *"Renewable Energy Engineering and Technology", by Kishore VVN, Teri Press, New Delhi (2010).*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME732	DES	NANO TECHNOLOGY AND APPLICATIONS	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

(A) This course on nanotechnology covers the basic scientific concepts of nanoscience. Understand the properties of nano materials, characterization of materials, synthesis and fabrication. Understand the applications of nano technology in various science, engineering and technology fields. (B) This course shall be very helpful to the engineering student to develop essential skill & knowledge of the nanotechnologies and nano materials in demand.

Course Outcomes (COs):

After learning the course the students should be able to:

1. Understand the importance & role of nanotechnology and Nanoscience.
2. Apply the knowledge of properties of different Nanomaterials based on the application requirement.
3. Understand the 2D, 3D structures of Nanomaterials.
4. Understand the Methods by which Properties can be Measure.
5. Understand the Applications of Nano Technology.

Syllabus

Unit-I

Introduction of Nanotechnology

History of nano science, Introduction to Nanotechnology, Nanotechnology –Definition – Difference between Nanoscience and Nanotechnology, definition of nano meter. Evolution of science and technology.

Unit-II

Nanomaterials and Properties

Nanomaterials :–Definition, Classification of nano materials, Crystal symmetries, crystal directions, crystal planes, Band structure.Mechanical properties, electrical properties, dielectric

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properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

Unit-III

Types of Nanostructures

Definition of a Nano system - Types of Nanocrystals-One Dimensional (1D)-Two Dimensional (2D) -Three Dimensional (3D) nanostructured materials - Quantum dots – Quantum wire Core/Shell structures.

Unit-IV

Methods of Measuring Properties

Crystallography, particle size determination, surface structure, Scanning Prob Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Elecrtron Microscopy (TEM).

Unit-V

Applications of Nano Technology

Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin fins, applications of quantum dots.

Reference Books:

1. *"Nanotechnology: Basic science and Emerging technologies", by M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.*
2. *"The chemistry of nanomaterials: Synthesis, properties and applications", by C.N.R.Rao, A.Muller, A.K.Cheetham (Eds), Wiley VCH Verlag Gmbh&Co, Weinheim, 2004.*
3. *"Nanoscale Materials Science", by Kenneth J. Klabunde (Eds), John Wiley & Sons, InC, 2001.*
4. *"Nano Electronics and information Technology", by W. Rainer, Wiley, 2003.*
5. *"Nano systems" by K.E.Drexle , Wiley, 1992.*
6. *"Naostructures and Nanomaterials: Synthesis, properties and applications", by G.Cao, Imperical College Press, 2004.*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME742	DES	SQC AND TOTAL QUALITY MANAGEMENT	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

To introduction with (A) Modern quality control techniques to include the design of statistical process control systems, (B) Acceptance sampling and process improvement, (C) Quality Principles, Tools and Techniques.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Student would be able to understand the need of Quality, and its concepts and need.
2. Student would be able to understand various available statistical tools of quality monitoring.
3. Student would be able to analyses basics of Quality Management and able to understand various management tools and techniques.
4. Students would be able to understand the statistical and economical design issues associated with the monitoring tools.
5. Students will be able to understand the basics of Quality Function Deployment and its tools and techniques.

Syllabus

Unit I

Introduction of Statistical quality Control &TQM

Quality: Definition, need, evolution ,The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management : quality philosophy(Contributions of Deming, Juran and Crosby, links between quality and productivity, quality costs legal aspects of quality implementing quality improvement).

Unit II

Methods and Philosophy of Statistical Process Control

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Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, ARL, sensitizing rules for control charts); Deming's Magnificent Seven Implementing SPC; An Application of SPC; Nonmanufacturing application of SPC.

Unit III

Control Charts for Variables

Control Charts for $\bar{X}$ and R (statistical basis, development and use, estimating process capability; interpretation, the effect of non normality on the chart, the OC function, and average run length); Control Charts for $\bar{X}$ and S; Control Chart for Individual Measurements; Applications of Variables Control Charts.

Unit IV

Inferences about Process Quality

Sampling distributions, estimation and confidence interval for process parameter(s), hypothesis testing on process parameter(s) and power analysis, Process Capability Ratios, Process Capability Analysis, Exponentially Weighted Moving Average Control Chart, Moving Average Control Chart

Unit V

TQM Tools & Techniques I &II

Seven traditional tools of quality, new management tools, Six-sigma: Concepts, methodology, application to manufacturing, service sector including IT, Bench marking: reason, process. FMEA, Just-In-Time, Kanban system MRP vs JIT system, Waste elimination, workers involvement through JIT. QFD, Taguchi quality loss function, Inspection: acceptance sampling, OC curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.

Reference Books:

1. *"Statistical Quality Control" by E.L. Grant and R.S. Leavenworth, 6th edition, McGraw-*
2. *Hill publisher.*
3. *"Principles of Quality Control", by Jerry Banks, Wiley publisher.*
4. *"Total Quality Management" by D. H. Besterfiled; Pearson Education Asia, Third Edition, Indian Reprint, 2006.*
5. *"The Management and Control of Quality" by J. R. Evans and W. M. Lindsay; South-Western (Thomson Learning), Sixth Edition, 2005.*
6. *"Total Quality Management" by Naidu, Babu and Rajendran; New age International pub; First Edition Reprint, 2013*

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME703	DES	INDUSTRIAL AUTOMATION AND PRODUCTION SYSTEM	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

To introduce the students with the Industrial Automation and their application with Production system.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes, the students will be able to

1. To identify potential areas for automation and justify need for automation.
2. To select suitable major control components required to automate a process or an activity.
3. To translate and simulate a real time activity using modern tools and discuss the benefits of automation.
4. To identify suitable automation hardware for the given application.
5. To recommend appropriate modelling and simulation tool for the given manufacturing application.

Syllabus

Unit-I

Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. (SLE: Analysis of Transfer Lines)

Unit – II

Material handling and Identification Technologies: Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods. (SLE: Material Identification Methods).

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Unit – III

Control Technologies in Automation: Industrial Control Systems, Process Industries versus Discrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms. (SLE: Sensors, Actuators and other Control System Components).

Unit – IV

Computer Based Industrial Control: Introduction& Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules and SCADA Systems & RTU.

Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems. (SLE: Display Systems in Process Control Environment.)

Unit – V

Assembly Lines: Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines. Line balancing problem, largest candidate rule, Ki Bridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design. Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines.

Reference Books:

1. *"Automation, Production Systems and Computer Integrated Manufacturing", by M. P. Groover, Pearson Education.5th edition, 2009.*
2. *"Computer Based Industrial Control", by Krishna Kant, EEE-PHI,2nd edition,2010*
3. *"An Introduction to Automated Process Planning Systems", by Tiess Chiu Chang & Richard A. Wysk*
4. *"Performance Modelling of Automated Manufacturing Systems", by Viswanandham, PHI, 1st edition, 2009.*
5. *"Automation, Production systems and computer integrated manufacturing", by Mikel P. Groover, Pearson Education.*
6. *"Automation, Buckinghsm", by W, Haper& Row Publishers, New York, 1961.*
7. *"Automation for Productivity", by Luke H.D, John Wiley & Sons, New York, 1972.*

List of Experiments:

1. To study the various components of automation of production system.
2. To study the material handling system and its automation principles.
3. To study the various components of industrial control systems.
4. Development of human machine interface using any SCADA package.
5. Study of distributed control systems.
6. Study of automated production lines.
7. Case studies on industrial automation and production systems.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME704	DCS	REFRIGERATION AND AIR CONDITIONING	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

To introduction with (A) Refrigeration, (B) Vapour Compression Refrigeration, (C) Unconventional Refrigeration Systems and Future Trends (D) Psychrometric and Air conditioning loads calculation.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes -

1. Students would be able to understand the Refrigeration system, and its importance, need and applications.
2. Students would be able to analyses basics of vapour compression refrigeration.
3. Students would be able to understand desirable properties of refrigerants.
4. Students will be able to understand absorption refrigeration system.
5. Students would be able to calculation of psychrometric properties of air by tables and charts.
6. Students would be able to calculation of summer & winter air conditioning load.

Syllabus

Unit - I

Introduction to Refrigeration

Principles and methods of refrigeration, freezing; mixture cooling by gas reversible expansion, throttling, evaporation, Joule Thomson effect and reverse Carnot cycle; unit of refrigeration, coefficient of performance, vortex tube & thermoelectric refrigeration, adiabatic demagnetization; air refrigeration cycles- Joule's cycle Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles.

Unit - II

Vapour Compression Refrigeration

Vapor compression cycle, p-h and t-s diagrams, deviations from theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi-pressure system:

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removal of flash gas, multiple expansion & compression with flash inter cooling; low temperature refrigeration: production of low temperatures, cascade system, dry ice, production of dry ice, air liquefaction system,.

Unit – III

Unconventional Refrigeration Systems and Future Trends

Vapor Absorption Systems: absorption cycle, Lithium-bromide system, heat-exchangers, analyzer and diffusers; The Electrolux system; Steam-Jet Refrigeration, Thermo-Electric Refrigeration. Low-temperature refrigeration: Cascade systems, Joule-Thompson effect, liquefaction of gases, application areas.

Refrigerants: nomenclature & classification, desirable properties, common refrigeration, comparative study, leak detection methods, environment friendly refrigerants and refrigerant mixtures, brine and its properties.

Unit – IV

Psychrometric

Calculation of psychrometric properties of air by table and charts; psychrometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; principle of air conditioning, requirements of comfort air conditioning, ventilation standards, infiltrated air load, fresh air load human comfort, effective temperature & chart, heat production & regulation of human body,

Unit-V

Air Conditioning Loads

calculation of summer & winter air conditioning load, bypass factor of coil, calculation of supply air rate & its condition, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation. Air distribution and ventilation systems.

Note: Refrigerant tables, Refrigeration and Air-conditioning Data Book and certified data tables are allowed in the examination hall.

References

1. "Refrigeration and Air Conditioning", by C. P. Arora, Tata McGraw Hill.
2. "Refrigeration and Air Conditioning", by A. R .Trott and T. C. Welch, Butterworth-Heinemann.
3. "Refrigeration and Air Conditioning Technology", by Whitman, Jhonson and Tomczyk, Thomson Delmer Learning.
4. "Refrigeration and Air Conditioning", by Abdul Ameen, Prentice Hall of India Ltd.
5. "Basic Refrigeration and Air Conditioning", by P. N. Ananthanarayan, Tata McGraw Hill.

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
MBAI301C	ODS	HUMAN VALUES AND PROFESSIONAL ETHICS	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Objectives (COs):-

The objective of the course is to (A) disseminate the theory and practice of moral code of conduct and (B) familiarize the students with the concepts of "right" and "good" in individual, social and professional context

Course Outcomes (CEOs):-

1. Help the learners to determine what action or life is best to do or live
2. Right conduct and good life
3. To equip students with understanding of the ethical philosophies, principles, models that directly and indirectly affect business.

Syllabus

Unit-I

Human Values: Values, Type of Values –competent, instrumental, terminal, extrinsic & intrinsic values; Hierarchy of values; Dysfunctionality of values. Basis of values: Philosophical, Psychological and socio-cultural.

Unit-II

Theories and Models of Value Development: Theories of Value Development -Psycho-analytic, learning theory –social leaning, Models of Value Development -Value Analysis, Inquiry, Social Action.

Unit-III

Professional Ethics: Meaning, Objectives, Sources of Ethics, Ethics V/s Morals and Values, Ethico-Moral Action, Theories of Ethics, Codes of Ethics.

Unit-IV

Human Behavior – Indian Thoughts: Guna Theory, Sanskara Theory, Karma Theory, Nishkama Karma Yoga and Professionalism.

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Unit-V

Globalisation and Ethics: Impact of globalization on Indian corporate and social culture, Corporate Citizenship, Environmental Protection, Social Welfare and Community Development Activities.

Reference Books:

1. *"Society and Politics in India", by Beteille Andre (1991), Athlone Press, Latest edition*
2. *"Values and Ethics for Organizations", by Chakraborty S. K. (1999), Oxford University press, Latest edition*
3. *"Business Ethics - An Indian Perspective", by Fernando, A.C. (2009), Pearson Education, India, Latest edition*
4. *"Engineering Ethics", by Charles D. Ledermann (2012), Pearson Education / Prentice Hall, New Jersey, (Indian Reprint), Latest edition*
5. *"Ethics and the Conduct of Business", by Boatwright John R (2012), Pearson Education, New Delhi, Latest edition*
6. *"Business ethics", by Crane, Andrew and Matten Dirk (2015), Oxford University Press Inc., New York., Latest edition*
7. *"Business Ethics – Text and Cases, Murthy", by C.S.V. (2016), Himalaya Publishing House Pvt. Ltd., Latest Edition*
8. *"Professional Ethics and Human Values", by Naagrajan, R.R (2016), New Age International Publications, Latest edition*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME705	DS	MINOR PROJECT	0	0	0	50	50	0	0	6	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
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Syllabus

Purpose

To carry out a design project in one of the specializations of the program with substantial multidisciplinary component.

Instructional Objectives

To guide the students in such a way so that they carry out a work on a topic as a forerunner to the full-fledged project work to be taken subsequently in VIII semester. The project work shall consist of substantial multidisciplinary component

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME706	DS	COMPUTATIONAL FLUID DYNAMICS LAB	0	0	0	0	30	0	0	4	2

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs)

(A)Introduction to floating point arithmetic. Introduction to numerical methods for Euler and Navier-Stokes equations with emphasis on error analysis, consistency, accuracy and stability. (B)Modified equation analysis (dispersion vs. dissipation) and Von Neumann stability analysis. (C)Finite difference methods, finite volume and spectral element methods. Explicit vs. implicit time stepping methods. Solution of systems of linear algebraic systems. (D)Higher-order vs. higher resolution methods. Computation of turbulent flows.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes students will be able

1. To understand mathematical characteristics of partial differential equations.
2. To understand basic properties of computational methods – accuracy, stability, consistency
3. To learn computational solution techniques for time integration of ordinary differential equations
4. To learn computational solution techniques for various types of partial differential equations
5. To learn how to computationally solve Euler and Navier-Stokes equations
6. To acquire basic programming and graphic skills to conduct the flow field calculations and data analysis.

Syllabus

Unit - I

Introduction: Introduction to Computational Fluid Dynamics, Need of CFD, Uses of CFD, Application and Recent Scenario.

Unit - II

Governing Equations and Discretization / Integration Fundamentals: Compressible Navier-Stokes / Euler equations, Incompressible Navier-Stokes / Euler equations, Potential equations Cartesian Grids, structured grids, and unstructured grids, Finite difference, finite volume, finite element, and Discontinuous Galerkin methods.

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Unit - III

Numerical solution of the potential equations: Potential equations, Finite element methods, Numerical solution of a linear system.

Unit – IV

Numerical solution of the compressible Euler equations: Mathematical properties of the Euler equations, Discontinuous Galerkin (DG) finite element methods.Upwind methods: Upwinding for a scalar equation, Flux-Vector Splitting (FVS) methods, Low-diffusion FVS schemes, Godunov's exact Riemann solver, Roe's approximate Riemann solver, Boundary conditions.

Unit-V

Numerical solution of the compressible Navier-Stokes equations: Discretization of viscous and heat conduction terms, Bassi-Rebay method, Local discontinuous Galerkin method, Inter-cell reconstruction method.

Reference Books:

1. *"Numerical Computation of Internal and External Flows", by Hirsch, C., 2nd ed., Butterworth-Heinemann, 2007, ISBN 9780750665940 (E-Book available).*
2. *"Computational Fluid Mechanics and Heat Tranfer", by Pletcher, R. H., Tannehill, J. C., Anderson, D., 3rd ed., CRC Press, 2011, ISBN 9781591690375.*
3. *"Fundamentals of Engineering Numerical Analysis", by Moin, P., 2nd ed., Cambridge University Press, 2010, ISBN 9780521805261.*
4. *"Numerical Methods for Engineering Application", by Ferziger, J. H., 2nd ed., Wiley, 1998.*
5. *"Computational Methods for Fluid Dynamics", by Ferziger, J. H., Peric, M., 3rd ed., Springer, 2002.*

List of Experiments

1. Introduction to Modeling and simulation software.
2. Solution for the one dimensional wave equations using explicit method of lax using finite difference method (code development).
3. Solution for the one dimensional heat conduction equation using explicit method using finite difference method (code development).
4. Generation of the Algebraic Grid (code development).
5. Generation of the Elliptic Grids (code development).
6. Introduction to ANSYS Modeling and simulation software.
7. Numerical simulation of Flow over an airfoil using software.
8. Numerical simulation of Flat plate boundary layer using software.
9. Numerical simulation of Laminar flow through pipe using software.
10. Numerical simulation of Flow past cylinder using software.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME707		MECHATRONICS LAB	0	0	0	0	20	0	0	2	1

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

To introduction with (A)To enable the student to understand the modern mechatronics component.(B)To present the underlying principles and alternatives for mechatronics systems design.(C)To provide the student with the opportunity for hands-on experience with the related components of the technology for diverse domains of application

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. To understand the working of Sensors AND Transducers
2. To understand the principle and working of System models and Controllers, Logic Controllers.
3. Able to Design Mechatronics System

Syllabus

Unit - I

Mechatronics, Sensors AND Transducers: -Introduction to Mechatronics Systems – Key elements, Information systems, Real time interfacing, Elements of data acquisition system. Sensors and Transducers – Performance Terminology – Sensors for Displacement,Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Range sensors, Light Sensors, Humidity, Vibration. Special transducers - Piezoelectric transducer – Magnetostrictive transducer - Shape memory alloy (SMA) transducer. – Selection of Sensors.

Unit - II

SignalConditioning:-Signal Conditioning & Interfacing Microcontroller- Comparison between microprocessor and micro controller, organization of a microcontroller system, architecture of controller and Applications. Computer Numerical Control systems (a) Position and velocity control loops (b) Adaptive Control applications for machine tools like lathe, grinding etc. Digital Logic Control – Micro Processors Control.

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Unit - III

System models and Controllers: Building blocks of Mechanical, Electrical, Fluid and Thermal Systems. Rotational – Translational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – DigitalControllers – Velocity Control – Adaptive Control.

Unit - IV

ProgrammingLogicControllers:-PLC: Introduction to the design and mode of operation of programmable logic control (PLC) – Basic Structure– Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analog Input / Output – Selection of a PLC.

Unit-V

Designof Mechatronics System: Introduction to MEMS, Micro sensors in mechatronics, Sensors for condition monitoring, Artificial intelligence in mechatronics, Stages in designing Mechatronics Systems – Traditional and Mechatronic Design Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- piece counting system, Autonomous mobile robot-Wireless surveillance balloon- Engine Management system- Automatic car park barrier.

Reference Books:

1. *"Basic Mechanical Engineering" by D.K.Gupta & A. Kumar; Publisher: Dhanpat Rai & Co., 2009.*
2. *"Mechatronics", by Bolton, Pearson education, second edition, fifth Indian Reprint, 2003*
3. *"Mechatronics integrated technologies for intelligent machines", Smaili.A and Mrad.F Oxford university press, 2008*
4. *"A Textbook of Mechatronics", Rajput. R.K, S. Chand & Co, 2007*
5. *"Introduction to Mechatronics and Measurement Systems", Michael B. Histand and David G. Alciatore McGraw-Hill International Editions, 2000.*
6. *"Mechatronics", Bradley D. A., Dawson D., Buru N.C. and Loader A.J, Chapman and Hall, 1993.*
7. *"Mechatronics" Dan Necsulesu, Pearson Education Asia, 2002 (Indian Reprint).*
8. *"Mechatronics", HMT, Tata McGraw-Hill Publishing Company Ltd., New Delhi 2004.*

List of Experiments:

1. Study of Various Types of Transducers.
2. Proportional Integral Derivative (PID) controller interfacing.
3. Basic cylinder sequencing operations using Pneumatic trainer Kit.
4. Study and Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.

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5. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW.
6. Basic operations and interfacing of Sensors in Lab view.
7. Study of PLC and Its Applications.
8. Study of frequency response of closed loop systems using MATLAB.
9. Speed Control of AC & DC drives.
10. Servo controller interfacing for DC motor.
11. Stepper motor interfacing with 8051 Micro controller.

(i)Full step resolution (ii) half step resolution.

12. Write a program to run a stepper motor in clockwise direction and in anticlockwise direction.

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