Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Technology and Science

Choice Based Credit System (CBCS) Scheme in light of NEP-2020

B. Tech. in Mechanical Engineering

(2023 - 2027)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME601A	DSE	OPERATION RESEARCH AND SUPPLY CHAIN	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 10 marks.

Course Educational Objectives (CEOs):

This course provides a fundamental understanding of (A) linear programming, assignment models and transportation model (B) Network model, waiting line models and game theory (C) Supply chain management.

Course Outcomes (COs):

After completion of this course the students will be able to describe the followings:

1. Students will be able to solve linear-programming problems.
2. Students will be able to solve assignment and transportation problems.
3. Students will be able to do network analysis, waiting line problems and game theory.
4. Students will be able to understand & describe supply chain, inventory management and supply chain integration.

Syllabus

Unit-I **(10 Hrs)**

Introduction: History and development of Operations Research; Scientific Methods, Characteristics, Scope, Models in Operations Research.

Linear Programming: Formulation, graphical methods, simplex method, Big- M- method. **Linear programming models:**

Assignment Models: Definition, Mathematical Representation, Formulation and Solution, Alternate optimal solution.

Transportation Models: Definition, Formulation and solution, Alternate optimal solution, Stepping stone method, Modified distribution (MODI) or u-v method.

Sequencing Models: Processing n jobs through two machines, m machines and processing two jobs through m machines, minimal path problem

Unit-II **(9 Hrs)**

Network Analysis: Network diagram, Time estimation, Basic steps in PERT and CPM, PERT computation, CPM computation, critical path, Float, Cost analysis, crashing the network.

Unit-III **(9 Hrs)**

Waiting Line and Dynamic programming Models:

Waiting Line Model: Introduction, classification, state in queue, probability distribution of arrival and service times, Single server model (M/M/I), Multiple server model (MMS), Birth and death

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process.

Dynamic Programming: Introduction, Distribution characteristic, dynamic programming approach, optimal subdivision problem.

Unit-IV **(10 Hrs)**

Game Theory: Game Theory and Simulation Theory of Game, Competitive game, two persons, zero sum games, maxima and minima Principles, Saddle point, Method of Dominance, graphical and algebraic method of solution by transforming into linear programming problem, Monte-Carlo simulation and application.

Unit-V **(10 Hrs)**

Supply Chain and its Importance: Introduction and advantages of SC, Key National and International issues.

SC Integration: Push, pull and push-pull systems, SC strategies, direct shipment, cross-docking transshipment, centralized versus decentralized control, central versus local facilities.

SC Inventory Management and Risk Pooling: Single warehouse inventory, the economic lot size model, the effect of demand uncertainty, supply contracts, multiple order opportunities, continuous review policy, variable lead times, periodic review policy, risk pooling, centralized versus decentralized systems, forecasting techniques. Bullwhip effect, information and SC trade-offs.

Planning Demand and Supply in a SC: Demand forecasting in SC, Aggregate planning in a SC. Logistics and SC Network Configuration

Text and Reference Books:

1. "Introduction to Operations Research" by Hillier F.S., and Lieberman G.J., Tata McGraw Hill, 2005.
2. "Operations Research: An Introduction" by Taha H.A., Pearson, 2006.
3. "Operations Research" by Taha, Tata McGraw Hill, 2002.
4. "Textbook of Logistics and Supply Chain Management" by D. K. Agrawal, Macmilan, 2003.
5. "Fundamentals of Supply Chain Management: Twelve Drivers of Competitive Advantage" by John T. Mentzer, SAGE Publications, 2004.
6. "Operations Research" by Perm Kumar Gupta, Dr. D.S Hira, S.Chand publication, 2010.
7. "Operations Research" by Wagner, PHI. New Delhi, 2003.
8. "Operations Research" by Hira and Gupta, S. Chand., 2008.

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU601B	DE	ROBOTICS ENGINEERING	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 10 marks.

Course Educational Objectives (CEOs):

Students able to develop a (A) comprehensive understanding of the historical evolution and current state of robotics technology, (B) Identify and evaluate real-world robotics applications, (C) contributing to advancements in various industries and addressing societal challenges.

Course Outcomes (COs):

After completion of this course the students are expected to be able to

1. Introduce the fundamental principles and concepts of robotics engineering, including robot components, types, and applications.
2. Explore various drive systems used in robots, such as wheels, tracks, and legs, and understand their advantages and limitations in different applications.
3. Understand robot dynamics to predict and control the motion and forces exerted by robots during tasks.
4. Develop programming skills for robot control using high-level languages and robot-specific programming languages.

Syllabus

Unit I

Introduction: Introduction History of robots, Classification of robots; Present status and future trends. Basic components of robotic system; Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom; Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

Unit II

Drive systems and Sensors: Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

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BTAU601B	DE	**ROBOTICS ENGINEERING**	60	20	20	0	0	3	1	0	**4**

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

Kinematics and Dynamics of Robots: 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.

Unit IV

Robot Control: Robot Controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions; Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control.

Unit V

Programming and Applications: Introduction to Robotic Programming, On-line and off-line programming, programming examples; Robot Applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting.

Reference Books:

1. *"Industrial Robotics, Technology programming and Applications" by Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, McGraw Hill, 2012.*
2. *"Introduction to Robotics- mechanics and control" by Craig. J. J., Addison- Wesley, 1999.*
3. *"Robotics Technology and flexible automation" by S.R. Deb, Tata McGraw-Hill Education., 2009*
4. *"Robotics Engineering an Integrated Approach" by Richard D. Klafter, Thomas A, ChriElewski, Michael Negin, PHI Learning., 2009*
5. *"Engineering foundation of Robotics" by Francis N. Nagy, Andras Siegler, Prentice Hall Inc., 1987.*

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BTAU601B	DE	**ROBOTICS ENGINEERING**	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 10 marks.

6. *"Robotics and Image Processing an Introduction" by P.A. Janaki Raman, Tata McGraw Hill Publishing company Ltd., 1995*
7. *"Kinematic Analysis of Robot manipulators" by Carl D. Crane and Joseph Duffy, Cambridge University press, 2008*
8. *"Robotics control, sensing, vision and intelligence" by Fu. K. S., Gonzalez. R. C. & Lee C.S.G., McGraw Hill Book co, 1987*
9. *"Robots and Manufacturing Automation" by Ray Asfahl. C., John Wiley & Sons Inc., 1985.*

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BTAU601C	DE	MODERN VEHICLE TECHNOLOGY	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 10 marks.

Course Educational Objectives (CEOs):

Students will be able to understand the latest advancements in vehicle design, powertrains, safety features, and connected technologies. Foster critical thinking and problem-solving skills to address challenges and opportunities in modern vehicle technology.

Course Outcomes (COs):

Students will be able to:

1. Provide an understanding of the latest trends and developments in modern vehicle design and engineering.
2. Introduce advanced powertrain technologies, including hybrid and electric propulsion systems.
3. Examine the latest safety features and innovations in vehicle crashworthiness and active safety systems.
4. Explore the integration of connected technologies, including telematics and vehicle-to-everything (V2X) communication.

Syllabus

UNIT I

Introduction to Modern Vehicle Technology: Evolution of automotive technology, Trends and challenges in the automotive industry.

Advanced Powertrain Technologies: Hybrid powertrains: Series, parallel, and series-parallel configurations, Electric vehicles: Battery-electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), Fuel cell vehicles (FCVs) and alternative propulsion systems.

UNIT II

Connected Vehicle Technologies: Global Positioning Systems, Geographical Information Systems, Navigation Systems, Automotive Vision System, Road Recognition, Driver Assistance Systems – Connected Vehicles, Telematics and vehicle connectivity, Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication, Autonomous Vehicles, Levels of autonomy and self-driving capabilities, Challenges and opportunities in autonomous vehicle development.

UNIT III

Comfort Systems: Active Suspension Systems, Requirement and Characteristics, Different Types, Power Steering, Collapsible and Tiltable Steering Column, Power Windows, Biometric Systems.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU601C	DE	MODERN VEHICLE TECHNOLOGY	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Adaptive Control Systems: Adaptive Cruise Control, Adaptive Noise Control, Anti Spin Regulation.

UNIT IV

Vehicle Safety Innovations: Active and Passive Safety Systems, Airbags, Seat Belt Tightening System, Collision Warning Systems, Child Lock, Anti-lock braking (ABS), electronic stability control (ESC), and autonomous emergency braking (AEB), Advanced Driver Assistance Systems (ADAS), Adaptive cruise control (ACC) and lane-keeping assist, Blind-spot monitoring and forward collision warning. Crash Worthiness of Vehicle, Vehicle Crash Testing, Testing with Dummies. Security Systems - Anti Theft Technologies, Smart Card System, Number Plate Coding.

UNIT V

Advanced Materials in Vehicle Design: Lightweight materials; Aluminum, composites, and high-strength steel. Impact on vehicle performance, fuel efficiency and safety.
Future Trends and Environmental Considerations: Urban mobility and shared mobility concepts, Innovations in vehicle design and human-machine interfaces. Vehicle emissions and environmental impact, Sustainable mobility solutions and green transportation.

Text & References Books:

1. *"Automotive Technology: A Systems Approach" by Jack Erjavec and Rob Thompson, Cengage Learning, 2019.*
2. *"Electric and Hybrid Vehicles: Design Fundamentals" by Iqbal Husain Publisher, CRC Press, 2010.*
3. *"Vehicle Crashworthiness and Occupant Protection" by Du Bois, Paul, et al., Automotive Applications Committee, American Iron and Steel Institute, Southfield, Michigan (2004).*
4. *"Introduction to Autonomous Robots: Mechanics, Sensors, Algorithms" by Nikolaus Correll, Bradley Hayes, et al., CRC Press 2022.*
5. *"Connected vehicles: Technology review, state of the art, challenges and opportunities." By Abdelkader, Ghadeer, Khalid Elgazzar, and Alaa Khamis. Sensors 21.22 (2021): 7712.*
6. *Automotive Vehicle Safety by George A. Peters, Barbara J. Peters, SAE 2002.*
7. *Bosch Hand Book, 3rd Edition, SAE,1993.*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU602A	DE	HYBRID AND ELECTRIC VEHICLES	60	20	20	0	0	3	0	0	0

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 10 marks.

Course Educational Objectives (CEOs):

Students will be able to (A) understand of electric and hybrid vehicle technology, including the historical background, current state, and future prospects. (B) Develop a broader awareness of electric and hybrid vehicle applications, (C) contributing to the advancement of clean and sustainable transportation solutions.

Course Outcomes (COs):

Students are expected to be able to:

1. Grasp the principles and technologies behind electric and hybrid vehicle propulsion systems, including energy storage solutions and motor torque calculations.
2. Acquire the skills to design electric vehicle architectures and integrate various components for optimal performance.
3. Demonstrate competence in electric drive and controller design, contributing to the development of efficient and sustainable electric and hybrid vehicles.
4. Evaluate battery management system requirements and implement strategies to enhance battery life and safety in electric vehicles.

Syllabus

Unit – I

Introduction: History, Components of electric vehicle, Comparison with internal combustion engine: Technology, Comparison with internal combustion engine: Benefits and challenges, EV classification and their electrification levels. EV terminology.

Unit – II

Energy Storage Solutions (ESS): Cell Types (Lead Acid/Li/NiMH), Battery charging and discharging calculation, Cell Selection and sizing, Battery lay outing design, Battery pack configuration, Battery pack construction, Battery selection criteria.

Motor Torque Calculations for Electric Vehicle: Calculating the rolling resistance, calculating the grade resistance, calculating the acceleration force, finding the total tractive effort, torque required on the drive wheel.

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BTAU602A	DE	HYBRID AND ELECTRIC VEHICLES	60	20	20	0	0	3	0	0	0

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

Electric Vehicle Architecture Design: Types of electric vehicle and components, Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV, Comparison of fuel vs electric and solar power, Solar power operated electric vehicles, Case study.

Unit – IV

Electric Drive and controller: Types of motors, Selection and sizing of motor, RPM and torque calculation of motor, Motor Controllers, Component sizing, Physical locations, Mechanical connection of motor, Electrical connection of motor.

Unit – IV

Battery Management System Requirement: Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, communication interface, Range estimation, State-of-charge estimation, Cell total energy and cell total power.

Indian and Global Scenario: Technology Scenario, Market Scenario, Policies and Regulations, Payback and commercial model, Polices in India.

Text & Reference Books:

1. *"Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design" by M. Ehsani, Y. Gao, S. Gay and Ali Emadi; Publisher: CRC Press, 2005*
2. *"Electric and Hybrid Vehicles: Design Fundamentals" by Iqbal Husain; Publisher: CRC Press, 2003.*
3. *"Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles" by Sheldon S. Williamson; Springer, 2013.*
4. *"Modern Electric Vehicle Technology" by C.C. Chan and K.T. Chau; Publisher: OXFORD University Press, 2001*

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BTAU602A	DE	HYBRID AND ELECTRIC VEHICLES	60	20	20	0	0	3	0	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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5. *"Hybrid Electric Vehicles Principles and Applications with Practical Perspectives" by Chris Mi, M. Abul Masrur, David Wenzhong GAO; Publisher: Wiley Publication, 2011.*
6. *"Electric Vehicle Technology Explained" by James Larminie, John Lowry Wiley, 2003.*
7. *"Battery management systems, Volume I: Battery modeling by Plett, Gregory L. Artech House, 2015.*
8. *"Battery management systems, Volume II: Equivalent-circuit methods by Plett, Gregory L. Artech House, 2015.*
9. *"Battery Management Systems - Design by Modelling" by Bergveld, H.J., Kruijt, W.S., Notten, P.H.L Philips Research Book Series 2002.*

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BTAU602B	DE	TOTAL QUALITY MANGEMENT	60	20	20	0	0	3	0	0	**0**

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 10 marks.

Course Educational Objectives (CEOs):

Students will be able to apply (A) Total Quality Management (TQM) principles to foster a culture of quality excellence within organizations, (B) promoting a proactive approach to quality control and customer satisfaction, (C) identifying areas for improvement to achieve higher efficiency.

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.
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.

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 philosophies (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: 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

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU602B	DE	TOTAL QUALITY MANGEMENT	60	20	20	0	0	3	0	0	0

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 10 marks.

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: 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-Hill publisher, 1988.*
2. *"Principles of Quality Control", by Jerry Banks, Wiley publisher, 1989.*
3. *"Total Quality Management" by D. H. Besterfiled, Pearson Education Asia, Third Edition, Indian Reprint, 2006.*
4. *"The Management and Control of Quality" by J. R. Evans and W. M. Lindsay; South-Western (Thomson Learning), Sixth Edition, 2005.*
5. *"Total Quality Management" by Naidu, Babu and Rajendran; New age international pub; First Edition Reprint, 2013*

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B. Tech in Automobile Engineering

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU602C	DE	MATERIAL HANDLING AND STORAGE SYSTEMS	60	20	20	0	0	3	0	0	**0**

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 10 marks.

Course Educational Objectives (CEOs):

Students will be able to (A) acquired the necessary expertise in material handling and storage systems and optimize efficient material movement. (B) They will be capable of applying their knowledge to solve practical challenges and (C) contribute to streamlined operations and enhanced productivity.

Course Outcomes (COs):

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

1. To familiarize students with the fundamentals of material handling, including the principles, importance, and key concepts.
2. To introduce students to common material handling systems, both traditional and automated, and equip them with the knowledge of selecting and implementing appropriate systems.
3. To enable students to understand the various storage systems used in industrial and manufacturing sectors, including their design considerations, capacity planning, and optimization.
4. To empower students to demonstrate their understanding of material handling and storage systems through various case studies, allowing them to analyze real-world.

Syllabus

Unit I

Introduction: Definitions, Objectives, Cost of handling, Design handling, Material factors, Automated material handling systems, Scope of material handling, Application of material handling equipment, Modern trends in material handling.

Unit II

Common Material Handling Equipment's: Concepts of unit loads, Material handling and storage equipment's operation and selection, Containers, Pallets, Conveyor systems, Industrial trucks, Wagon tipplers, Transporters, Stackers, Reclaimers, Silos & hoppers and their accessories, Ropeways, Ship loaders, Cable cranes, Container handling systems, Electric lifts & Hoists, EOT cranes, Elevators, Material handling equipment's in steel mills, Power plants, Mines, Automobile and transport industries, Large scale constructions etc.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU602C	DE	MATERIAL HANDLING AND STORAGE SYSTEMS	60	20	20	0	0	3	0	0	**0**

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 10 marks.

Unit III

Automated Material Handling: Material handling function; Types of material handling equipment. Analysis of material handling Systems; consideration of material and movement conditions, material handling analysis techniques, Design of the System: effect of plant layout, principles of material handling, Conveyor Systems: types of conveyors, quantitative relationships and analysis of conveyor systems, Automated guided vehicle systems (AGVS): types of AGVS, applications, vehicle guidance and routing, traffic control and safety, system management, quantitative analysis of AGV Systems.

Unit IV

Storage Systems: Storage System Performance: Types of materials stored in factory, storage capacity, system throughput, storage transactions, utilization, uptime reliability; Automated Storage / Retrieval Systems (AS/RS); Definition, important categories of automated storage /retrieval system, basic components of an AS /RS, AS/RS controls, special features and applications.

Unit-V

Case Studies: Case study related to manufacturing and industrial practices.

Reference Books:

1. *"Automation, Production Systems and CIM", by Groover. M. P., Prentice Hall India, 2007*
2. *"Manufacturing Automation", by Morris A. Cohen, Uday M. Apte., Irwin, Chicago, 1997.*
3. *"Robots and Manufacturing Automation", by Ray Asfahl. C., 2nd edition, John Wiley & Sons, New York, 1999.*
4. *"Facilities planning", by James A. Tompkins., John wiley & Sons Inc, 1994*
5. *"Principles of layout and material handling", by James. M. Apple, Ronald press, 1977.*
6. *"Introduction to Materials Handling" by Siddhartha Ray, New Age International Private Limited; Nineteen edition, 2017.*

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B. Tech in Mechanical Engineering

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME603	DCC	MECHANICAL VIBRATION	60	20	20	30	20	3	1	2	5

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 10 marks.

Course Educational Objectives (CEOs)

This course provides a fundamental understanding of (A) Vibration and noise in mechanical system and machines (B) Design modifications to reduce the vibration and noise(C) increase the life of components and control noise.

Course Outcomes (COs)

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

1. Understand free and forced vibrations of single degree freedom systems.
2. Analyze balancing problems in rotating and reciprocating machinery.
3. Understanding causes, source and types of vibrations in machineries.
4. Gaining knowledge in sources and measurement standard of noise.
5. Ability to design and develop vibrations and noise control systems.

Syllabus

Unit – I (10 Hrs)

Fundamental Aspects of Vibrations: Definition of Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems.

Un-damped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton's second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: compound pendulum.

Unit – II (9 Hrs)

Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME603	DCC	MECHANICAL VIBRATION	60	20	20	30	20	3	1	2	**5**

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 10 marks.

Unit – III **(9 Hrs)**

Harmonically excited Vibration: One degree of freedom, forced harmonic vibration vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments).
Whirling Motion and Critical Speed: Whirling motion and Critical speed: Definitions and significance. Critical speed of a vertical, light flexible shaft with single rotor: with and without damping .Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Unit – IV **(9 Hrs)**

Systems With Two Degrees of Freedom: Un-damped free vibration of 2 d.o.f and Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Unit-V **(8 Hrs)**

Noise Measurement & Control: Noise and its causes, sound pressure / intensity / power level and their inter-relation, Decibel scale, Loudness and equal loudness contours, Effect of machine / process noise on operators, employees and local residents. Standards of noise level and exposure limit, Methods of industrial noise control, Measurement of noise, Sound spectra and octave band analysis. Background noise, weighted networks.

Text Books:

1. "Theory of Vibrations with Applications" by W.T. Thomason, M.D. Dahleh and C. Padmanabhan, Pearson, 2008.
2. "Text book of Mechanical Vibrations", by Dukikipati RV Srinivas J; Publisher PHI, 2012.
3. "Mechanical Vibrations" by S.S. Rao, Pearson, 2018.

Reference Books:

1. "Mechanical Vibrations and Noise Engineering", by Ambekar A.G; Publisher: PHI, 2013.
2. "Element of Vibration Analysis", by Meirovitch Leonard Publisher: TMH, 2010

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME603	DCC	MECHANICAL VIBRATION	60	20	20	30	20	3	1	2	5

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 10 marks.

3. "Mechanical Vibrations", by Kelly SG and kudari SK; Publisher: Schaum Series; TMH, 2011.
4. "Mechanical Vibrations" by G.K. Grover, Nem Chand & Bros, 2009.
5. "Vibrations and waves in continuous mechanical systems" by P. Hagedorn and A. Das Gupta, John Wiley, 2007.

List of Experiments

1. To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account
2. To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system
3. To find out natural frequency and damped free frequency of a torsion pendulum and, hence to find out coefficient of damping of the oil
4. To observe the phenomenon of 'whirl' in a horizontal light shaft and to determine the critical speed of the shaft
5. To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.
6. To demonstrate the principle of tuned Un-damped Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting natural frequencies
7. To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter

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B. Tech in Automobile Engineering

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU602	DCS	CHASSIS AND BODY ENGINEERING	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 10 marks.

Course Educational Objectives (CEOs):

Students will be able to capable of designing and analyzing robust and safe automotive chassis and body structures, integrating their knowledge to develop vehicles with optimal performance, durability, and crashworthiness.

Course Outcomes (COs):

After the successful completion of this course

1. Students will be able to understand about automobile chassis and Engine components.
2. Students will be able to understand about working of braking, steering, clutch, transmission, Suspension systems.
3. Students will be able to understand about knowledge about different aspects related to body and chassis.
4. Students will be able to understand about vehicle body ergonomics design.
5. Students will be able to understand about various safety provisions of automotive bodies.

Syllabus

Unit I

Automotive Chassis: Definition; chassis layout; types of chassis layout with reference to power plant location and drive on wheels; chassis components; chassis classification; Automotive frames: Construction; functions; Loads acting on vehicle frame and materials for frames; frame cross sections; frame diagnosis and service; dimensions of wheel base; wheel track; chassis overhang.

Unit II

Front Axle & Steering System: Functions, construction & Types of Front Axles and Stub Axles; Ackerman's Steering Mechanisms; Steering linkages & layout; Types of steering gear boxes; Power assisted steering; Electronic steering; Four-wheel steering, Front wheel Geometry namely- Castor, Camber, Kingpin inclination, toe-in and toe-out, Condition for true rolling motion, center point steering, directional stability of vehicles, under-steer, over-steer.

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU602	DCS	CHASSIS AND BODY ENGINEERING	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 10 marks.

Suspension System: Need for Suspension System; Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar; Independent Suspension, Pneumatic suspension; Hydraulic suspension; Shock Absorbers -liquid & gas filled and Constructional details.

Unit III

Braking System: Principle of braking; classification; Drum brake, Disc brake, Parking brake - theory, principle and construction. Stopping Distance Time and Braking Efficiency, Effect of weight transfer during braking, Hydraulic Braking, Mechanical Braking, Pneumatic Braking, Power–Assisted Braking- theory, vacuum-booster basics, hydraulic-booster basics, Anti–Lock braking system.

Wheel & Tyre: Different types of wheels and rims and their constructional details; Forces acting on wheels, construction of wheel assembly, types- spoke, disc & built-up wheels; Different Types of Tyers and their constructional details, tyre specifications and material properties of tyres & tubes, Static & rolling properties of tyres, types of tyre-wear & their causes; tyre rotation.

Unit IV

Vehicle Body: Classification of vehicle based on body types; Types of vehicle bodies, Integral body construction details: Requirements of body, loads on the vehicle body: Static load, Acceleration and Braking, Moments and Torque due to driving conditions (torsion and bending moments); Types of materials used in body construction, analysis and selection of body member sections.

Unit V

Ergonomic and Vehicle Safety: Introduction of ergonomics; anthropometric dimensions of standard occupant; Concept of H-point referencing, interior design for ergonomics and comfort, seat design for ride comfort, suspension seats, split frame seating, back passion reducers; dash board instruments, pedal controls and electronic displays.

Vehicle Safety: Safety aspects in design, Types of safety (Active and Passive), Safety features: overview of requirement for occupant protection (frontal, side, rear and rollover impact) and

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU602	DCS	CHASSIS AND BODY ENGINEERING	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 10 marks.

pedestrian safety, Airbags and Seatbelts; Visibility: Regulation, Driver's visibility, Methods of improving visibility, Introduction of crash test, Chassis and body alignment test.

Text Books:

1. *"Automobile Engineering Vol.-1" by Kripal Singh, Standard Publishers, 2000.*
2. *"A Text–Book of Automobile Engineering" by R.K. Rajput, Laxmi Publications Private Limited, 2014.*
3. *"Automotive Chassis" by Heldt. P. M.- Chilton Co., New York- 1990*
4. *"Vehicle Body Engineering", by Jnusz Pawlowski, Publisher: Business books limited, 1970.*
5. *"An Introduction to Modern Vehicle Design", by J H Smith Publisher: Butterworth-Heinemann, 2001.*
6. *"Motor Vehicle Structure: Concepts and Fundamentals'', by J Brown, A J Roberstson, S Serphento, Publisher: Butterworth-Heinemann, 2002.*
7. *"Advanced Vehicle Technology", by Heinz Heizler, Publisher: Butterworth-, London, 2002.*
8. *"Ergonomics in Automotive Design", by V D Bhinse, Publisher: CRC Press, 2011.*
9. *"Handbook of Automotive Body and Systems Design", by John Fenton Publisher: Wiley India, 2013.*
10. *"Handbook of Automotive Body Construction and Design Analysis", by John Fenton, Publisher: Wiley India, 1998.*

References Books:

1. *"Mechanics of Road Vehicles" by Steed W - Illiffe Books Ltd., London- 1960*
2. *"Motor Vehicles", by Newton Steeds and Garrot- Butterworths, London- 2000.*
3. *"Mechanism of the Car", by Judge A.W Chapman and Halls Ltd., London- 1986*
4. *"Steering, Suspension and tyres", by Giles.J.G- Iiiffe Book Co., London- 1988.*
5. *"Automotive Chassis and Body", by Crouse W.H- McGraw-Hill, New York- 1971.*

List of Experiments:

1. Study of types of chassis layouts.
2. Study and Construction of front axle
3. Study and Construction of steering linkages.

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU602	DCS	CHASSIS AND BODY ENGINEERING	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 10 marks.

4. Study and Construction of rigid axle and independent suspension system.
5. Study and Construction of disc & drum brake assemblies.
6. Study of development and construction of vehicle body
7. Study of various body materials.
8. Study of various types of car bodies.
9. Study different types of bus and commercial vehicle body.
10. Study the ergonomics associated with automobile body design.
11. Study of vehicle safety aspects and safety features.

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU605	DCS	AUTOMOTIVE COMPONENT DESIGN	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 10 marks.

Course Educational Objectives (CEOs):

To make the students understand (A) the design concept and principles of various engine Components (B) Selection of proper material for engine components (C) Developing the ability to analyze problem, weight alternatives and find the suitable solution.

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 fundamental aspect of design.
2. Students will be able to select and design the different automobile components.
3. Students will be able to standardize the different parts.
4. Students will be able to give reasons of assumptions made while designing the component with reference to manufacturing assembly, thermal and wear considerations point of view.

Syllabus

Unit I

Introduction: Engineering materials and their physical & mechanical properties applied to design; selection of materials, factor of safety, endurance limit, notch sensitivity; principles of design optimization, future trends and computer aided drafting.

Unit II

Limits, Fits, Tolerances, Surface Finish, Shafts and springs: Definitions, types of tolerances and fits; design considerations for interference fits, surface finish, surface roughness; design of power transmission shafts and design of helical springs.

Unit III

Design of Cylinder and Piston: Choice of material for cylinder and piston, piston friction, piston slap; design of cylinder, piston, piston pin, piston rings, piston failures, lubrication of piston assembly.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU605	DCS	AUTOMOTIVE COMPONENT DESIGN	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 10 marks.

Unit IV

Design of Connecting Rod, Crankshaft: Material for connecting rod; determining minimum length of connecting rod, small end and big end design, shank design, design of big end cap bolts; connecting rod failures; balancing of I.C. Engines, significance of firing order; material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations.

Unit V

Design of Valves and Flywheel: Design aspects of intake and exhaust manifolds; inlet and Exhaust valves, valve springs, tappets, valve train; Materials and design of flywheel.

Reference Books:

1. *"An Introduction to Modern Vehicle Design" by Julian Happian-Smith, BH, 2001.*
2. *"Automobile Chassis Design and calculations", by P. Lukin, Mir Publishers, 2002.*
3. *"Automotive Mechanics" by N. K. Giri, Khanna Publishers, 1998.*
4. *"Machine Design", by Sadhu Singh, Khanna Publishers, 2015.*
5. *"Automobile Chassis Design", by Dean Averns, L. life Books Ltd., 1992.*
6. *"Automobile Engineering Vol-I & II", by Kripal Singh, Standard Pub., 2011.*
7. *"Automobile Engineering Vol-I & II" by K. M. Gupta, Umesh Pub., 2001.*
8. *"Mechanical Engineering Design", Fourth Edition, by Joseph E. Shigley & Larry D. Mitchell, McGraw- Hill International Book Company, 1993.*

List of Experiments

1. To standardize the given automobile part for size, torque and power point of view.
2. To design the spur, helical, bevel and worm gear for given situation of automobile vehicle.
3. To design the engine cylinder for given situation of automobile vehicle.
4. To design the piston for given situation of automobile vehicle.
5. To design the flywheel for given situation of automobile vehicle.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU605	DCS	AUTOMOTIVE COMPONENT DESIGN	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 10 marks.

6. To design the valve and valve mechanism for given situation of automobile vehicle.
7. To design the connecting rod for given situation of automobile vehicle.
8. To give reason of design.

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME606	AESE	SIMULATION OF MECHANICAL SYSTEM LAB	0	0	0	30	20	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 10 marks.

Course Educational Objectives (CEOs)

This course develop the knowledge of (A)concepts of modeling (B) computer aided modelling and various modeling tools to represent mechanical systems(C) Understand various techniques of simulation (D)Apply modeling and simulation techniques to simulate industrial systems/mechanical systems using different software packages.

Course Outcomes (COs)

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

1. Understand modeling and simulation using various softwares / programming languages.
2. Familiar with modeling software's such as Creo.
3. Ability to simulate the physical behavior of systems using Ansys, Matlab & Simulink.
4. Ability to analyze results obtained from these simulation tools.
5. They are able to do modeling and simulation of mechanical systems.

Syllabus

Unit – I **(10 Hrs)**

Modeling Basics: Models, modeling purpose, objectives and examples of models
Principles of Physical Modeling: Concept of System and environment, basic relationship; Continuous and discrete systems; Linear and non-linear systems; stochastic activities, Bond Graphs.

Unit – II **(10 Hrs)**

Computer Aided Modeling: Solid modeling of component using Creo, finite element modeling using ANSYS; Static and Dynamic models, Estimating Transient Response, Spectra and Frequency Functions; Parameter Estimation in Dynamic Models; System Identification as a Tool for Model Building.

Unit – III **(10 Hrs)**

Basic Simulation Modeling: Role of simulation in model evaluation and studies, advantages of simulation.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME606	AESE	SIMULATION OF MECHANICAL SYSTEM LAB	0	0	0	30	20	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 10 marks.

System Simulation: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques.

Unit – IV **(10 Hrs)**

System Simulation and Its Types: Continuous system model; Analog and Hybrid simulation; Feedback system; Computers in simulation studies, Simulation software packages.
System Dynamics: Growth and Decay models, Logistic curves, System dynamics diagrams.

Unit-V **(12 Hrs)**

Simulation of Mechanical Systems: Building of Simulation models, simulation of translational and rotational mechanical systems, Simulation of electro mechanical, thermo - mechanical, hydraulic & pneumatic elements; Case studies related to industrial problems.

Text and Reference Books:

1. "Modeling and Simulation with HDL", by George Pelz, John Wiley & Sons Ltd, 2003.
2. "Modeling Analysis and Control of Dynamic Systems", by W.J. Palm, John Wiley, 1999.
3. "System Simulation" by Gordon, G; Prentice Hall, 2008.
4. "Modeling of Dynamic Systems" by Lennart, L. and Torkel, G., Prentice Hall, 2016.
5. "Mathematical Modeling for Design of Machine Components", by Bhonsle, S.R., and Weinmann, K.J., Prentice Hall, 1999.
6. "Bond Graph in Modeling, Simulation and Fault Identification", by Mukherjee, A., Karmaker, R. and Samantaray, A.K., I & K Internationa, 2009.
7. "Systems Modeling & Analysis", by I.J. Nagarath & M. Gopal, Tata McGraw Hill, 2005.

List of Experiments

1. Introduction to CAD (Creo) and FEM analysis software package(Ansys)
2. Solid modeling of structural components using Creo.
3. Introduction to 2D and 3D Meshing.
4. Finite element analysis of structural component using Ansys.
5. Static structural analysis of machine component using Ansys.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME606	AESE	SIMULATION OF MECHANICAL SYSTEM LAB	0	0	0	30	20	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 10 marks.

6. Mode analysis of machine component using Ansys.
7. Nonlinear structural analysis using Ansys.
8. Static thermal analysis using Ansys.
9. Transient thermal analysis using Ansys.
10. Transient analysis of vibrating system Ansys.
11. Introduction to durability analysis of Mechanical component using Ansys.
12. Introduction to rigid body dynamic analysis using Ansys.
13. Introduction to Topology optimization and Structure/Weight Optimization.
14. MATLAB tutorial for simulation of various mechanical systems.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU607	SEC	VEHICLE ELECTRICAL AND ELECTRONICS LAB	0	0	0	0	50	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 10 marks.

Course Educational Objectives (CEOs):

Students will gain (A) hands-on expertise in automotive electrical systems, including batteries, alternators, starters, and sensors, (B) allowing them to diagnose and troubleshoot vehicle components effectively and (C) ensure safe and reliable automotive performance.

Course Outcomes (COs):

After learning the course, the students should be able to:

1. Familiarize students with automotive batteries and accessories, enabling them to understand their construction and working principles.
2. Develop practical skills in analyzing and troubleshooting automotive electrical circuits using multimeters, oscilloscopes, and diagnostic tools.
3. Understand the fundamentals of charging systems in vehicles, including alternators, voltage regulators, and their role in maintaining battery charge and electrical power supply.
4. Gain proficiency in using various automotive sensors and activators and understanding their applications in vehicle control systems.

Syllabus

Unit-I

Batteries and Accessories: Principle and construction of lead acid battery; characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries; maintenance and charging.

Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods, horn, wiper system and trafficator.

Unit-II

System Engineering: Condition at starting, behavior of starter during starting, series motor and its characteristics; principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

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BTAU607	SEC	VEHICLE ELECTRICAL AND ELECTRONICS LAB	0	0	0	0	50	0	0	2	1

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

Charging System: Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments.

Unit-IV

Fundamentals of Automotive Electronics: Current trends in automotive electronic engine management system; electro-magnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system

Unit-V

Sensors and Activators: Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

Reference Books:

1. *"Understanding Automotive Electronics" by Bechhold Publisher SAE, 1998.*
2. *"Automobile Electrical Equipment" by Crouse W.H, Publisher: McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.*
3. *"Modern Electrical Equipment of Automobiles" by Judge A.W ", Publisher: Chapman & Hall, London, 1992.*
4. *"Automotive Electrical Equipment" by Kholi. P. L Publisher: Tata McGraw-Hill Co., Ltd., New Delhi, 1975.*
5. *"Automotive Hand Book" by Robert Bosch Publisher: SAE (5th Edition), 2000.*
6. *"Internal Combustion Engines" by Ganesan. V. Publisher: Tata McGraw-Hill Publishing Co., New Delhi, 2003.*

List of Experiments:

1. Testing battery voltage and state of charge using a multimeter and evaluating battery performance

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BTAU607	SEC	VEHICLE ELECTRICAL AND ELECTRONICS LAB	0	0	0	0	50	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 10 marks.

under different load conditions.

2. Diagnosing and replacing a faulty automotive battery.
3. Testing alternator output and voltage regulation under various engine speeds.
4. Diagnosing and rectifying alternator charging issues.
5. Checking starter motor operation and troubleshooting starting system problems.
6. Studying the construction and operation of an automotive alternator.
7. Investigating voltage regulation techniques in the charging system.
8. Understanding the role of a voltage regulator in maintaining battery charge.
9. Evaluating the output of various automotive sensors (temperature, pressure, etc.) using instrumentation.
10. Investigating the activation and response of actuators (solenoids, motors, etc.) under different conditions.
11. Calibrating and adjusting sensors in an engine control system.

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