Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Fourth Year Engineering

(Automobile Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – VII &VIII

W.E.F. 2020 – 21

Subject Group Code and Subject Groups

Sr. No.	GROUP	Category	Breakup of Credits (Total 171)
1	**A**	Humanities and Social Sciences including Management Courses (HSMC)	**10**
2	**B**	Basic Science Courses (BSC)	**30**
3	**C**	Engineering Science Courses including workshop, drawing, basics of electrical/mechanical/computer etc. (ESC)	**33**
4	**D**	Professional Core Courses (PCC)	**53**
5	**E**	Professional Elective Courses relevant to chosen specialization/branch (PEC)	**18**
6	**F**	Open subjects – Electives from other technical and /or emerging subjects (OEC)	**12**
7	**G**	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad (PROJ)	**15**
8	**H**	Mandatory Courses (MC) [Environmental Sciences, Induction program, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)
		Total	**171**

Kavayatri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering (Automobile Engineering)

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'A' Grade
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3rd Cycle

Syllabus Structure & Contents of Fourth Year of Engineering

Semester-VI

w.e.f. 2020 – 2021

Syllabus Structure for Fourth Year Engineering (Semester – VII) (Automobile Engineering) (w.e.f. 2020 – 21)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Design of Machine Elements	**D**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Professional Elective Courses – III	**E**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Professional Elective Course – IV	**E**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Open Elective Course – III	**F**	**3**	**--**	**--**	**3**	40	60	-	-	100	**3**
Design of Machine Elements Lab	**D**	**--**	**--**	**2**	**2**	--	--	25	25 (OR)	50	**1**
Autotronics Lab	**D**	**1**	**--**	**2**	**3**	--	--	25	25 (PR)	50	**2**
Project (Stage – I)	**G**	**--**	**--**	**12**	**12**	--	--	50	50 (OR)	100	**6**
Essence of Indian Traditional Knowledge	**H**	**--**	**--**	**--**	**--**	-	-	--	--	--	**0**
		13	**--**	**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – III	Professional Elective Course – IV	Open Elective Course – III
1) Vehicle Body Engineering	1) Vehicle Testing & Evaluation	1) Operation Research
2) Advance Transportation System	2) Advance Engine Technology	2) Mechanical Vibration
3) Automobile Tribology	3) Automobile Painting & Collision Repairs	3) Electronic Devices

Syllabus Structure for Fourth Year Engineering (Semester – VIII) (Automobile Engineering) (w.e.f. 2020 – 21)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Automobile System Design	**D**	3	--	--	3	40	60	--	--	100	**3**
Professional Elective Course – V	**E**	3	--	--	3	40	60	--	--	100	**3**
Professional Elective Course – VI	**E**	3	--	--	3	40	60	--	--	100	**3**
Open Elective Course – IV	**F**	3	--	--	3	40	60	-	-	100	**3**
Automobile System Lab	**D**	--	--	2	2	--	--	25	25 (OR)	50	**1**
Finite Element Analysis & Simulation Lab	**D**	2	--	2	4	--	--	25	25 (PR)	50	**3**
Project	**G**	--	--	6	6	--	--	50	50 (OR)	100	**3**
		14	**--**	**10**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – V	Professional Elective Course – VI	Open Elective Course – IV
1) Noise, Vibration & Harshness in Automobile	1) Vehicle Safety Technology	1) Entrepreneurship, Innovations & Startups
2) Electrical and Hybrid Vehicles	2) Automotive Materials	2) Mechatronic System
3) Special Purpose Vehicles	3) Heavy Vehicles and Earth Movers	3) Robotics

DESIGN OF MACHINE ELEMENTS					
COURSEOUTLINE					
Course Title:	**Design of Machine Elements**	**Short Title:**	**DOME**	**Course Code:**	

Course Description:

This course aims to equip the mechanical engineering students with the fundamentals of design activities and give them necessary skills to prepare complete, concise, and accurate calculation steps for machine elements. While the first part of the machine elements covering general stress analysis, failure conditions, shaft, spring, permanent and nonpermanent joints design, rolling contact and journal bearings, gears, clutches, flywheels, etc.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	03	14	42	03

Pre-requisite Course(s):

The sound knowledge of Mathematics (Calculus), Engineering Mechanics, SOM and TOM subjects

Course Objectives:

1. To understand procedure of machine design and develop an ability to apply it for simple component design by using design data hand book.
2. To understand the different theories of failure and develop an ability to apply its knowledge for design of mechanical component and determine the resisting areas against failure
3. To determine forces on transmission shaft and design of transmission shaft
4. To determine the endurance strength and design of components subjected to fluctuating loads
5. To determine the forces in welds and bolt joints and formulate design solution for size of weld and size of bolt
6. To study standard procedure of bearing selection from manufacturing catalogue

Course Outcomes:

After successfully completion of this course students will be able to:

1. apply knowledge of the stress and strain of mechanical components; and understand, identify and quantify factor of safety, failure modes for simple mechanical components (Shaft and Coupling) subjected to direct and bending and combined loading.
2. develop logical and analytical ability to apply knowledge of various theories of failures for design of joints, bolts, springs etc.
3. the selection of gear types, sizing, analysis and material selection of spur and helical gear systems.
4. the selection of gear types, sizing, analysis and material selection of bevel and worm gear systems.
5. estimate endurance strength of ductile and brittle materials and develop analytical ability to apply fatigue theories for ductile and brittle material in static and dynamic loading.

COURSE CONTENT

Design of Machine Elements		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**

	Duration of ESE:	**03 hours**
	Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Introduction and Design of Shaft and coupling	**No. of Lectures: 08 hours**	**Marks: 12**
Introduction of Machine Design, Basic procedure of Machine Design, Requisites of design engineer, Sources of design data, Design considerations - limits, fits and standardization, Selection of preferred sizes, Stress concentration - causes and remedies, Review of failure theories for static loading. Shafts: - Material, Design on the basis of strength considering shaft subjected to, twisting moment only, bending moment only, combine twisting and bending moment, axial load in addition to twisting and bending. Design on the basis of rigidity. A.S.M.E. code for shaft design. Couplings: - Design considerations, Classification, Design of Flange coupling and Flexible bushed pin coupling.		
Unit – II: Design of Joints, Spring	**No. of Lectures: 08 hours**	**Marks: 12**
Threaded Joints: - Stresses in threaded joint, Bolts of uniform strength, eccentrically loaded bolted joint, Torque requirement for bolt tightening. Welded Joints: - Types of welding and joints, strength of transverse and parallel fillet welded section, eccentrically loaded joint. Spring: - Types, Applications and materials of springs, Stress and deflection equations for helical springs, Style of ends, Wahl's Stress Factor, Design of helical compression and tension springs, leaf spring, nipping, Shot peening		
Unit – III: Design of Spur Gear and Helical Gear	**No. of Lectures: 09 hours**	**Marks: 12**
Spur Gears: Number of teeth and face width, Type of gear tooth failure, Desirable properties and selection of gear material, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength equation, Estimation of module based on beam and wear strengths, Estimation of dynamic tooth load by velocity factor and Buckingham's equation, Helical Gears: Transverse and normal module, Virtual number of teeth, Force analysis, Beam and Wear strengths, Effective load on gear tooth, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears.		
Unit – IV: Design of Bevel Gears and Worm Gear	**No. of Lectures: 09 hours**	**Marks: 12**
Bevel Gears Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis, Design criteria of bevel gears, Beam and wear strengths, Dynamic tooth load by velocity factor and Buckingham's equation, Effective load, Design of straight tooth bevel gears, Selection of material for bevel gears, Worm Gear Worm and worm gear terminology and geometrical relationship, Standards dimension, Force analysis of worm gear drives, Friction in worm gears and its efficiency, Worm and worm-wheel material, Beam strength and wear strength of worm gears, Thermal consideration in worm gear drive, Methods of Gears lubrication		
Unit – V: Design of Bearings and Design for Fluctuating Loads	**No. of Lectures: 08 hours**	**Marks: 12**

Rolling contact Bearings: Type of rolling contact bearing, Static and dynamic load carrying capacities, Striback's equation, Equivalent bearing load, Load-life relationship, Selection of bearing life, Selection of rolling contact bearings from manufacturer's catalogue. Design for cyclic loads and speed, bearing with probability of survival other than 90%. Design for Fluctuating Loads: Fluctuating stresses, Fatigue failure, Endurance limit, Notch sensitivity, Reversed stresses, Solderberg and Goodman diagrams, Fatigue design of components under combined stresses such as shafts, bolts and springs.
Text Books:
1. Bhandari V.B., "Design of Machine elements", Tata McGraw Hill Pub. Co. ltd. 2. Farzdak Haideri, "Machine Design", Nirali Prakashan, Pune 3. R. B. Patil, "Mechanical System Design" Techmax publications; 4th edition (2018)
Reference Books:
1. Shigley J.E., Mischke C.R., "Mechanical Engineering Design" McGraw Hill Pub. Co. Ltd. 2. Spott's M. F., Shoup T. E. "Design of Machine Elements", Prentice Hall International. 3. "Design Data", P.S.G. College of Technology, Coimbatore. 4. Juvinal R. C. "Fundamental of Machine Component Design", John Wiley and sons. 5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

VEHICLE BODY ENGINEERING

COURSEOUTLINE

Course Title:	Vehicle Body Engineering	Short Title:	VBE	Course Code:	

Course Description:

This course imparts knowledge in the construction of vehicles, concept aerodynamics, and different types of car and passenger bus bodies.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	03	14	42	03

Pre-requisite Course(s):

The sound knowledge of Mathematics (Calculus), Engineering Mechanics, SOM and TOM subjects

Course Objectives:

Students undergoing this course are expected:

1. To develop the basic knowledge of the students in design of the vehicle body to give maximum comfort for the passengers and exposed to the methods of stream lining the vehicle body to minimize drag.
2. To develop the skills of the students in the areas of car body design, bus body design, active and passive safety.

Course Outcomes:

After successfully completion of this course students will be able to:

1. discuss the different types of car body design and its safety features.
2. select a suitable body optimization technique to minimize drag and able to describe the wind tunnel testing procedure.
3. classify the various types of bus body construction and able to identify the body layout.
4. describe the different types of commercial vehicles and its design.
5. explain the various types of materials and painting techniques used in automobiles

COURSE CONTENT

Vehicle Body Engineering		Semester:	VII
Teaching Scheme:		Examination Scheme:	
Lectures:	3 hours/week	End Semester Exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit – I: Vehicle Bodies & Materials	No. of Lectures: 08 hours	Marks: 12

Introduction:

a. Classification, nomenclature of car body, different types of car body

b. Basic requirements & structures of different vehicle bodies regulations & standards

c. Constructional trends & styling Forms

Materials:

d. Timber, reinforced plastic moulding, sandwich construction, light alloys, Expanded Metals, Fasteners, Adhesives, Glass, Steel Sheets, Insulating Materials

e. Use Of Aluminium Structure For Bus Body Building.

Unit – II: Private Car Body Work	**No. of Lectures: 08 hours**	**Marks: 12**
a. Sheet metal construction, body work aerodynamics (drag & lift, pitching, yawing & rolling) forces & moments, sideways forces, hull sealing. b. Commercial vehicle body design - Bus & Truck body weight analysis, pay load, methods employed in loading & discharge c. Body builders drawing, body construction, floor construction		
Unit – III: Body Mechanism	**No. of Lectures: 09 hours**	**Marks: 12**
a. Design of windows, door construction, design of pluggage carrier, Design Of Spare Wheel Carrier, Design Of Passenger Seats b. Driver Seats, Comfort Factors, Circle of Riding Comfort, Effect of Discomfort, Safety Consideration c. Body Work Drafting: - Full Size Layout On Draft, Proportional Developments, Timber Framing For Composite Body Work , Body Draughtsman Curves		
Unit – IV: Auto Body Repairs & Testing	**No. of Lectures: 09 hours**	**Marks: 12**
Automated Assembly Systems: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis.		
Unit – V: Painting & Anti-Corrosion finish	**No. of Lectures: 08 hours**	**Marks: 12**
a. Introduction, Cleaning, Pretreatment, Priming, Finish Coating, Stoving, Internal Corrosion & Sealing, Materials of Construction b. Painting Processes, Protection Of A Finished Cars, Water Leaks, Water Drainage, System, Windscreens, Apron Panel & Heating/Ventilation, Rear Drip, Tail Gate		
Text Books:		
1. G.Y Wong "Theory of Ground Vehicle'; John Willey & Sons. 2. Raza N Jazzar, "Vehicle Dynamics"; Springler.		
Reference Books:		
1. Hans-Joachim Streitberger "Automobile Paints & Coatings, Wiley _ VCH Verlay GmbH & Co. KGaA 2. Hans-B Pacejka, Tyre & Vehicle Dynamics. 3. Jason c.Brown, A.John Robertson, "Motor Vehicle Structure "; Butterworth		

ADVANCE TRANSPORTATION SYSTEM					
COURSE OUTLINE					
Course Title:	**Advance Transportation System**	**Short Title:**	**ATS.**	**Course Code:**	
Course description:					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):
Engineering Mathematics
Course objectives:
1.To be aware of various methods of collecting traffic data 2. To understand the basics of highway planning and design, and workout problems in design of road geometrics To learn the importance of road safety
Course outcomes:
After successful completion of this course the student will be able to:
1. understand the concept of capacity 2. conduct traffic surveys 3. design the links and intersections 4. build safety into every aspect of design 5. apply latest technology as ANN

COURSE CONTENT			
Advance Transportation System		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to systems approach: Typical transportation systems - Mathematical models; Fundamentals of simulation - Monte Carlo method - Continuous and discrete models - Simulation languages; Probability concepts - Random numbers - Pseudo random generators - Arrival patterns - Service time distributions – Manual simulation of simple queuing system		
Unit–II:	**No. of Lectures: 10 Hours**	**Marks: 12**
GPSS Fundamentals: Creating and moving transactions - Queues and facilities - Event scheduling – Standard numerical attributes; Parameters and save values - Functions - Priority - Preemption - Collection of statistics; Report preparation. Internal logic of GPSS processor - Program control statements.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Applications of GPSS: Simple queuing problems - Inventory problems - Simulation of ports; Railway platforms and level crossings - Traffic signals. Analysis of simulation results; Model validation - Replication of random conditions - Time series analysis.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Genetic Algorithm: Terminology in GA – Strings, Structure, Parameter string - Data Structures; Operators - Algorithm – Application in Transportation. Fuzzy Logic.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Artificial Neural Networks: Basics of ANN – Topology - Learning Processes - Supervised and unsupervised learning; Least mean square algorithm, Back propagation algorithm - Applications.		
Text Books:		
1. Gordon, G., System Simulation, Prentice-Hall of India, 2005 2. J.M. Zurada, .Introduction to artificial neural systems.,Jaico Publishers, 2006		
Reference Books:		
1. GPSS/PC, User Manual, Minuteman Software, USA, 2005 2. David E. Goldberg, Genetic Algorithms in Search, Optimisation and Machine Learning, Addison-Wesley, 1989		

AUTOMOBILE TRIBOLOGY					
COURSEOUTLINE					
Course Title:	**Automobile Tribology**	**Short Title:**	**TRIBO**	**Course Code:**	

Course Description:

The course explains the range of surface treatments and advanced coatings that are designed to minimize wear, friction and surface oxidation / corrosion in IC engines.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s):

Fluid Mechanics

Course Objectives:

1. To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.
2. To select proper grade lubricant for specific application.
3. To understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
4. To introduce the concept of surface engineering and its importance in tribology.
5. To understand the behavior of Tribological components.

Course Outcomes:

After successfully completion of this course students will be able to:
1. Understand and perform basic design calculations of elastohydrodynamic lubrication and contact
mechanics problems, including rolling bearing, gears and cams contacts
2. Calculate surface topographical parameters of Surface properties & Friction
3. Understand the wear theories, types of wear, mechanism, factors and selection of materials
4. Understand the basic design calculations of hydrodynamic lubrication problems, including thrust bearings and journal bearings.
5. Understand Rheodynamics (Static) Lubrication characteristics, materials in extreme environments

COURSE CONTENT

Automobile Tribology		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Tribology	**No. of Lectures: 09 hours**	**Marks: 12**

Introduction, Applications, Tribology in Industry Tribology in Design, Economic Considerations;

Friction: Introduction, Kinds of Friction Laws of Friction, Causes of Friction, Friction Measurement, Stick Slip Oscillations & Its Elimination. Wear: Introduction, Types of Wear, Various Factors Affecting Wear Theory of Wear, Measurement of Wear, Wear Between Solids and Flowing Liquids, Theory of Wear		
Unit – II: Lubricants	**No. of Lectures: 09 hours**	**Marks: 12**
Lubricants: - Lubricant Properties - Physical and Chemical. Lubrication - Introduction, Basic Modes of Lubrication. Flow of Viscous Fluid Through Rectangular Slot. Seals-Mechanical and Dynamic Seals Hydrostatic Bearings: Basic Concept, Operations, Advantages and Limitations. Hydrostatic Conical and Spherical Bearings, Load Carrying Capacity and Flow of Lubricants. Bearing Power and Film Thickness, Bearing Temperature and Power. Compensators and Their Action. Optimum Design Step Bearing.		
Unit – III: Hydrodynamic Bearing	**No. of Lectures: 08 hours**	**Marks: 12**
Theory of Hydrodynamic Lubrication, Mechanism of Pressure Development in Oil Film; Two Dimensional Reynolds Equation, Infinite Tapered Shoe Slider Bearings and Infinite Long Journal Bearing. Short Bearing Theory Applied to Journal Bearing		
Unit – IV: Hydrodynamic Thrust Bearing	**No. of Lectures: 08 hours**	**Marks: 12**
Introduction, Flat Plate Thrust Bearing, Step Thrust Bearing, Tapered Land Thrust Bearing, Tilting Pad Thrust Bearing, Spring Mounted Thrust Bearing, Hydrodynamic Pocket Thrust Bearing Friction And Power Losses in Journal Bearings: Ratio of Heat Conducted, Evaluation Of Friction Loss in Concentric & Eccentric Journal Bearing & Quantity of Oil Flow With Circumferential Groove And Hole.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Hydrostatic Squeeze Film, Circular & Rectangular Plates, Impact Conditions Between Lubricated Solids, Applications to Journal Bearing Air Lubricated Bearings: -Tilting Pad Bearings, Electromagnetic Bearing, Hydrodynamic Thrust Bearing with Air Lubrications. Lubrication Practice, Quality Control & Management - Characteristics of Lubricating Methods Lubricating Devices & Systems, Organizing Application Charts		
Text Books:		
1. B. C. Majumdar “Introduction Tribology & Bearings”, H. Wheeler & Company Pvt. Ltd. 2. Cameron A. “Basic Lubrication Theory, Wiley Eastern Ltd.		
Reference Books:		
1. Fuller D. D., “Theory and Practice of Lubrication for Engineers”. John Wiley and Sons. 2. Halling J. “Principles of Tribology”, McMillan Press Ltd. 3. Hrassan & Powel, “Gas Bearing”.		

VEHICLE TESTING & EVALUATION

COURSEOUTLINE

Course Title:	**Vehicle Testing & Evaluation**	**Short Title:**	**VTE**	**Course Code:**	

Course Description:

The course aims to explain the principle of engines and vehicle electronic management system and different sensors used in the systems.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s):

Fundamental knowledge of IC Engine, Applied thermodynamic

Course Objectives:

1. Test and evaluate advanced vehicle technologies intended to advance vehicle efficiency and reduce the consumption of petroleum
2. Produce lifecycle fuel economy and cost data for vehicles that are utilizing these advanced technologies in fleets.
3. Provide benchmark data and performance trends for advanced technology vehicles and their interaction with their fueling infrastructure

Course Outcomes:

After successfully completion of this course students will be able to:

1. understand the role of various sensor
2. know construction and working principle and it influence in controlling pollution, enhancing safety of the vehicle.

COURSE CONTENT

Vehicle Testing & Evaluation		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Testing Of Vehicles	**No. of Lectures: 09 hours**	**Marks: 12**

a. Scope, Test Procedure, Vehicle Performance Trials, Instrumentation Calibration, Performance Evaluation Tests for Maximum Speed

b. Brake tests, steering torque measurement, engine test, use of chassis dynamometer for Vehicle Test

Unit – II: Evaluation & Measurement	**No. of Lectures: 09 hours**	**Marks: 12**

a. National Proving Ground, Various Testing Tracks: - High Speed Track, Belgian Pave Track, Corrugated Track, Deep Wading Through, Shallow Water Trough, Mud Track, Steering Pad, Serpentine Courses, Gradient Track.

b. Evaluation & Measurement: - Evaluation And Measurement Of Various Parameters Speed, Distance And Acceleration, Fuel Consumption, Vibration, Noise And Sound, Radio Interference, Exhaust Emission And Miscellaneous		
Unit – III: Component Testing	**No. of Lectures: 08 hours**	**Marks: 12**
a. Material Selection & Construction Of Cam Shaft, Types Of Cam Profile, Importance of Component Testing Methods of Failure, Feedback, Failure Pattern Testing and Correlation to Field b. Performance Evaluation and Endurance, Testing of Aggregates Such as – Engine And Its Aggregates / Components. Gear Box c. Clutch, Axles, Shock Absorber, Springs, Rubber Components, Auto Transmission, Various Filters, Head lamps, Spark Plug, Tires, Radiators, Injectors, Pumps, Electrical Item Brakes.		
Unit – IV: Vehicle Safety in Design / Manufacture	**No. of Lectures: 08 hours**	**Marks: 12**
a. Vehicle Configuration Requirements and Function Safety. Performance and Safety Suspension System, Steering System, Crach Worthiness. b. Morphology of Vehicles General Layout of Passenger Cars and Commercial Vehicles. Effects of Shocks and Vibrations On Human Being, Comfort Criteria c. Safety Regulation Of EEC And Central Motor Vehicles Rules		
Unit – V: Visibility & Lighting	**No. of Lectures: 08 hours**	**Marks: 12**
a. Illumination and Glare Front Rear and Side Visibility, Safety Glasses, Warning and Signaling Devices. Antitheft Devices, Child Protection Devices b. Study of Various Kinds of Collisions and Impacts Such as Frontal Side and Rear. Crush Zone, Bumpers, Roll Over. Stability & Safety, Seat Belts and Passenger Restraint Systems c. Methods Of Measurement Of CO, HC & (NO) X By Infrared, FID - Flame ionization Detector And Chemiluminescence's Methods.		
Text Books:		
1. Birch, "Automotive Chassis system" 2. CIRT & VRDE manuals		
Reference Books:		
1. Giles, "Vehicle operation and performance" 2. Giles , "Motor Vehicle inspection"		

ADVANCED ENGINE TECHNOLOGY					
COURSEOUTLINE					
Course Title:	**Advanced Engine Technology**	**Short Title:**	**AET**	**Course Code:**	

Course Description:

To explain the principle of engines and vehicle electronic management system and different sensors used in the systems.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s):

Basics of Electronics engineering

Course Objectives:

To explain the principle of engines and vehicle electronic management system and different sensors used in the systems.

Course Outcomes:

After successfully completion of this course students will be able to:

understand the role of various sensor, its construction and working principle and it influence in controlling pollution, enhancing safety of the vehicle.

COURSE CONTENT

Vehicle Testing & Evaluation		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Fundamentals of automotive electronics	**No. of Lectures: 09 hours**	**Marks: 12**

a. Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables.
b. Introduction to modern control strategies like Fuzzy logic and adaptive control.
c. Parameters to be controlled in SI and CI engines and in the other parts of the automobile.

Unit – II: Sensors	**No. of Lectures: 09 hours**	**Marks: 12**

a. Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors.
b. Throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque
c. Fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors, gyro sensors.

Unit – III: SI engine management	**No. of Lectures: 08 hours**	**Marks: 12**

a. Three-way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Group and sequential injection techniques.
b. Working of the fuel system components. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff.
c. Fuel control maps, open loop control of fuel injection and closed loop lambda control. Electronic ignition systems and spark timing control. Closed loop control of knock.

Unit – IV: CI engine management	**No. of Lectures: 08 hours**	**Marks: 12**

a. Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection.
b. Electronically controlled Unit Injection system.Layout of the common rail fuel injection system.
c. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valves

Unit – V: Vehicle management system	**No. of Lectures: 08 hours**	**Marks: 12**

a. ABS system, its need, layout and working. Electronic control of suspension – Damping control, Electric power steering.
b. Supplementary Restraint System of air bag system – crash sensor, seat belt tightening. Cruise control.
c. Vehicle security systems- alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

Text Books:

1. Eric Chowanietz "Automobile Electronics" SAE Publications, 1994
2. William B Ribbens "Understanding Automotive Electronics", SAE Publications, 1998

Reference Books:

1. Robert Bosch "Diesel Engine Management" SAE Publications, 2006.
2. Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006.

AUTOMOBILE PAINTING & COLLISION REPAIRS					
COURSEOUTLINE					
Course Title:	**Automobile Painting & Collision Repairs**	**Short Title:**	**APCR**	**Course Code:**	

Course Description:

An introduction to the use of hand and power tools, techniques of metalworking, body preparation, plastic fillers, fiberglass and SMC repair, sanding, and application of primers with emphasis on shop safety practices.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

Chemistry, Workshop Practice

Course Objectives:

The Automobile painting & collision repairs course will prepare students for careers in the Auto Collision Repair and Refinishing industry or career related jobs

Course Outcomes:

After successfully completion of this course students will be able to:

handle state-of-the-art instruments, materials and techniques employed in the Auto Collision Repair and Refinishing industry; appropriate safety training; problem-solving skills including analysis data; effective teamwork; effective oral and written communication skills; and proper record keeping techniques.

COURSE CONTENT

Automobile Painting & Collision Repairs		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Painting techniques	**No. of Lectures: 09 hours**	**Marks: 12**

a. Painting techniques & Topcoat refinishing, definition & objectives of painting, elements of paint, pigments, resin, solvent, paint drying, paint drying characteristics, drying forms & film mesh works.

b. Automobile paints, topcoat paints, special paint, painting method, spraying, immersion, painting new vehicles, body components, new vehicle painting process, global refinish system.

c. HVLP recommendations, sanding recommendations, wet sanding, dustless dry sanding, vehicle protective coating, unpainted surfaces, filling dented or irregular surfaces.

Unit – II: Painting Equipment	**No. of Lectures: 09 hours**	**Marks: 12**

a. Refinishing facilities, equipment's & tools & repainting process, refinish & OE paint, types, individual characteristics, painting & drying facilities, drying equipments, colour matching scales, air spray gun, and electrostatic painting equipments.

b. Accessories, repainting, types of paints & repainting process, spray gun, surface treatment, primer surface & sanding, fundamental of colour, match masking, top coat process. c. Whole body & block repainting, spot repainting, waxing, repainting of bumpers, metallic colour appearance charger due to painting conditions.		
Unit – III: Paint Defects & Causes	**No. of Lectures: 08 hours**	**Marks: 12**
a. Paint defects, causes & correction, small body paint repair, correction for paint finish defects. b. Defects occurring during painting, seeds fish eyes, orange peels, runs, blushing, shrinkage, bleeding, line holes, pretty traces, abrasion mane, blisters, peeling, spotting discoloration, chalking, yellowing, nibs, and loss of gloss. c. Repairing a hole small dert, cout truck bed, defects occurring with time, fale (absorption).		
Unit – IV: Health Effects & Safety	**No. of Lectures: 08 hours**	**Marks: 12**
a. Safety & cleanliness minor body repair, paint & solvent toxicity & its prevention, paint & solvent toxicity, toxicity prevention, five hazards, fire extinguishing, health & safety, organic solvents, heavy metals. b. Acute chronic effects, respiratory sensitization, skin & eye effects, stability of isocyanates, storage, incompatibility, hazardous decomposition, body filters, door dig repairs, scratch repair, drip repair.		
Unit – V: Paint Selection	**No. of Lectures: 08 hours**	**Marks: 12**
a. Paint mixing systems, OEM color selection process, paint codes, tints, mixing, paint mixing, single stage paint, and three stage paint, two tone paint, troubleshooting, and painting plastic parts. b. Flexible paint additives, painting new plastic parts, repairing plastic parts, compressed air supply equipments, air & fluid control equipment, hose & connections, air systems maintenance.		
Text Books:		
1. Anil Chikara, “Automobile Paint Techniques”, Satya Prakashan, New Delhi. 2. Micheal Crandell, “Painting For Collision Repair”		
Reference Books:		
1. Jim Richardson,” Pro paint and Body”, HP Trade, Ist edition. 2. Deninis Parki,” How to paint your cae”, Motorbooks.		

Operations Research					
COURSE OUTLINE					
Course Title:	**Operations Research**	**Short Title:**	O.R.	**Course Code:**	FILL HERE
Course description:					
Operations research (OR) have many applications in science, engineering, economics, and industry and thus the ability to solve OR problems are crucial for both researchers and practitioners. Being able to solve the real-life problems and obtaining the right solution requires understanding and modelling the problem correctly and applying appropriate optimization tools and skills to solve the mathematical model. The goal of this course is to teach you to formulate, analyze, and solve mathematical models that represent real-world problems.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):
Familiarity with linear algebra is required.
Course objectives:
Students to use quantities methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.
Course outcomes:
After successful completion of this course the student will be able to:
1. Use methods of the graph in solving linear program and to find the optimal solution 2. Use the method simplex and to find the optimal solution. 3. Build and solve Transportation Models and Assignment Models. 4. Describe the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type. 5. Build and solve Replacement Models and Sequencing Models.

COURSE CONTENT			
Operations Research		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**
Operation Research – An Introductions The history of OR, Definition, Features, of OR, models and modelling in OR, OR approach to problem solving, methods for solving OR models, phases of OR, Advantages of OR study, Shortcomings of OR approach, OR Models in Practice, Applications of OR.		
Unit–II:	**No. of Lectures: 10 Hours**	**Marks: 12**
Linear Programming- Introduction, general Stricture of LP model, Assumption of an LP model, Advantages and Limitations of Linear programming, Applications areas of LP, steps		

of LP Model formulation, Graphical solution methods of LP problem, maximization, minimization, feasible, infeasible and unbounded solution.
The simplex method Introduction, standard form of an LP problem, simplex algorithm (maximization, minimization case) Degeneracy in simplex problem, unbounded Infeasible solution.
Duality in Linear programming, formulation of dual LPP, Advantages of duality, rules for constructing the Dual from primal, sensitivity Analysis in LP

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Transportation problem introduction, mathematical model of transportation problem, Algorithm, methods for finding initial solution northwest corner method, least cost method, Vogel's Approximation method, test for optimality steps of MODI method, maximization problem, unbalanced, degeneracy, prohibited transportation Routes problem.
Assignment problem- introduction, mathematical models of assignment problem, solution method of assignment problem, Hungarian method, maximization case, unbalanced Restrictions on assignment, travelling salesman, problem.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Decision Theory- Introduction, steps in decision making process types of decision-making Environments, Decision tree.
Theory of games- introduction, Two-person Zero sum game, pure strategies, maximin, minimax principles, game with saddle point, mixed strategy games, The principles of dominance, games without saddle point, algebraic method, arithmetic method, sub game method, Graphical method.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Replacement and maintenance method- Introduction, types of failure- gradual failure, sudden failure Replacement of items whose efficiency deteriorates with time, Replacement of items that completely fail, individual replacement policy, Group replacement policy, staffing problem, failure trees.
Sequencing problem- Introduction notations, Terminology, and assumptions of sequencing problem, Processing n jobs through two machines, Processing n jobs through three machines, Processing n jobs through four machines, Processing n jobs through five machines Graphical method.

Text Books:

1. Gupta, P.K. and Hira, D.S. (2008) Operations Research. S. Chand and Company Limited, New Delhi.
2. S. D. Sharma, "Operation Research", Khanna Publication
3. Manohar Mahajan, "Operation Research", Dhanpat Rai and Co.

Reference Books:

1. Taha, "Introduction to Operations Research." PHI Publications.
2. J. K. Sharma, "Operation Research, Problem and Solution", Macmillan
3. N. D. Vohra, "Quantitative Techniques in Management", TATA McGraw Hill
4. Ravindran, "Operation Research Principles and Practice", Wiley India Pvt. Ltd. New Delhi
5. Wayne L. Winston, "Practical Management Science: Spreadsheet modelling and applications", Duxbury Press,

MECHANICAL VIBRATION

COURSEOUTLINE

Course Title:	Mechanical Vibration	Short Title:	MV	Course Code:	

Course Description:

This course introduces undergraduate students to Mechanical Vibration. The background required includes a sound knowledge of Mathematics (Calculus), Engineering Mechanics, Strength of materials and Theory of mechanics of second year and Third year Level. The course aims at imparting knowledge of Mechanical vibration.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s): Mathematics (Calculus) at First year level and strength of Materials, Theory of Machines at Second year Level.

Course Objectives:

1. To understand the fundamentals of Vibration Theory.
2. To be able to mathematically model real-world mechanical vibration problems.
3. To analyse oscillatory motion of dynamic systems and the forces associated with the motion.

Course Outcomes:

After successfully completion of this course students will be able to:

1. Determine the natural frequency of Fundamental of Vibrations & Undamped Free Vibrations.
2. Analyze the Damped Free &Forced Vibrations of Single Degree of Freedom Systems.
3. Compute the natural frequencies Two Degree of Freedom Systems.
4. Select the numerical methods to determine Multi Degree of Freedom Systems Exact Analysis.
5. Describe the vibration measurement Continuous Systems & Non-Linear Vibrations

COURSE CONTENT

Mechanical Vibration		Semester:	VII
Teaching Scheme:		Examination Scheme:	
Lectures:	3 hours/week	End Semester Exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit – I:	No. of Lectures: 09 hours	Marks: 12

FUNDAMENTAL OF VIBRATIONS- Introduction, Definitions, Vector method of representing harmonic motions, Addition of two simple harmonic motions of the same frequency, Beat phenomenon, Complex method of representing harmonic vibrations, Work done by a harmonic force on a harmonic motion. UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS - Introduction, Derivation of differential equation, Solution of differential equation, Torsional vibrations, Equivalent stiffness of spring combinations, Energy method.

Unit – II:	No. of Lectures: 09 hours	Marks: 12

DAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS- Introduction, Different types of damping's, Free vibrations with viscous damping, Logarithmic decrement. Viscous dampers, Dry friction or coulomb damping, Solid or structural damping, Slip or interfacial damping. FORCED VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS- Introduction, forced vibrations with constant harmonic excitation, Forced vibrations with rotating and reciprocating unbalance, Forced vibrations due to excitation of support. Vibration isolation and transmissibility.		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
TWO DEGREE OF FREEDOM SYSTEMS- Introduction, Principal modes of vibration, Other cases of simple two degree of freedom systems, Combined rectilinear and angular modes. System with damping, Undamped forced vibrations with harmonic excitation, Vibration absorbers.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
MULTI DEGREE OF FREEDOM SYSTEMS EXACT ANALYSIS- Introduction, Free vibrations equations of motion, Influence coefficients, Generalized coordinates and coordinate coupling. Natural frequencies and mode shapes, Forced vibrations by N's second law of motion, Torsion vibrations of multi-rotor systems. MULTI DEGREE OF FREEDOM SYSTEMS NUMERICAL METHODS- Introduction, Rayleigh's method, Dunkerley's method, Stodola's method.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
CONTINUOUS SYSTEMS- Vibrations of strings, Longitudinal vibrations of bars, Torsional vibrations of circular shafts, Lateral vibrations of beams. NON-LINEAR VIBRATIONS- Introduction, Examples of non-linear systems, Phase plane, Undamped free vibration with nonlinear spring forces, Pertubation method, Forced vibration with non-linear spring forces, Self-excited vibrations.		
Text Books:		
1. V. P. Singh, "Mechanical Vibrations", Dhanpat Rai & Co. (P) Ltd., Delhi 2. G. K. Grover "Mechanical Vibrations", New Chand & Bros Roorkee (U.P.)		
Reference Books:		
1. Dilip Kumar Adhwarjee "Theory and Applications of Mechanical Vibrations", Laxmi Publications (p) Ltd., New Delhi 2. Leonard Meirovitch "Element of Vibration Analysis" Tata McGraw-Hill Publishing Company Limited, New Delhi 3. Singiresu S. Rao "Mechanical Vibrations", Pearson Education Ptd. Ltd., Delhi 4. S. Graham Kelly "Schaum's Outlines Mechanical Vibrations", Tata McGraw-Hill Publishing Company Limited, New Delhi 5. B. H. Tongue," Principles of Vibration", 2/ed. Oxford University Press, New Delhi		

ELECTRONIC DEVICES

COURSE OUTLINE

Course Title:	Electronic Devices	Short Title:	ED	Course Code:	

Course description:

This is a fundamental course, basic knowledge of which is required by all the engineers in every sphere of engineering & industry. This course includes study of semiconductor based electronic devices such as diodes, bipolar junction transistors, FETs, SCR, Integrated circuits its applications and related components. This course is designed to introduce to the students to the basic principles, characteristics, analysis and applications of electronic devices.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	3

Prerequisite course(s):

Introduction to basics of Electronics Engineering

Course objectives:

1. To deliver the knowledge about physics of basic semiconductor devices and circuits.
2. To enhance comprehension capabilities of students through understanding of electronic devices and circuits.
3. To perform DC and AC analysis of single stage amplifiers
4. To introduce and motivate students to the use of advanced electronic devices.
5. To analyze and design electronic circuits using semiconductor devices

Course outcomes:

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

1. Students will be able to explain working of electronic devices.
2. Students will be able to analyze characteristics of semiconductor devices like diode, BJT, FET, MOSFET, OPAMP etc.
3. Students will be able to perform DC and AC analysis of Electronics circuits.
4. Students will be able to select best circuit for the given specifications/application.
5. Students will be able to learn the different power devices and their applications.

COURSE CONTENT

Electronic Devices		Semester:	V
Teaching Scheme:		Examination scheme	
Lectures:	3 hours/week	End semester exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

SEMICONDUCTOR DIODES:

PN junction diode, Current equation, equivalent circuit of diode, Breakdown in PN Junction Diodes, Diode applications: Full wave Rectifier with capacitor filter Circuit, Clipper, Clamper, Voltage Multipliers. Principle of Operation and Characteristics of Tunnel Diode, Power diode, Varactor Diode, Photo diode, Zener diode characteristics, Zener as regulator.

Unit–II:	No. of Lectures: 09Hours	Marks: 12
BIPOLAR JUNCTION TRANSISTORS: Operating Point, The DC and AC Load line, Need of biasing, Voltage Divider Bias, Bias Stability, Hybrid parameter model of BJT for Low frequency, Analysis of a Transistor Amplifier Circuit using h - Parameters for Common Base, Common Emitter and Common Collector Configurations, Comparison of CB, CE, and CC Amplifier Configurations.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
FIELD EFFECT TRANSISTORS: JFET, MOSFET and their parameters, Transfer characteristics equations, JFET Biasing, Different biasing methods, FET as Voltage Variable Resistor, JFET Small Signal Model, Small signal analysis of JFET for Common Source Amplifier and Common Drain Amplifier, Comparison of MOSFET with JFET and BJT.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
OPERATIONAL AMPLIFIER AND TIMER CIRCUIT : Block diagram of OPAMP, Differential Amplifier - Ad, Ac & CMRR, OPAMP Applications: Inverting and Non inverting amplifier, Voltage follower (Buffer), Instrumentation Amplifier, Active first order filter: Low pass and high pass filter; IC 555 timer Operating modes: monostable, astable multivibrator.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
POWER DEVICES AND DISPLAY DEVICES SCR Construction & V-I characteristics, UJT triggering circuit, turning-off of a SCR (preliminary discussion), Gate Turn-off thyristor (GTO), Structure and V-I characteristics of Triac and Diac, Applications of Triac-Diac circuit. Power BJT, IGBT, Power MOSFET-DMOS-VMOS, LED, LCD, Photo transistor, Opto Coupler, Solar cell.		
Text Books:		
1. Millman and Halkies, “Integrated Electronics”, TATA McGraw Hill. 2. David A. Bell, “Electronic Devices and Circuits” Oxford.		
Reference Books:		
1. R.L. Boylestad and Louis Nashelsky, " Electronic Devices and Circuit Theory", Pearson 2. S. Salivahanan, N. Suresh Kumar,“Electronic Devices and Circuits”, Tata McGraw Hill 3. T. Floyd, “Electronics Devices” conventional current version, Pearson, 4. D. Cheruku, B. Tirumala Krishna, “Electronics Devices and Circuits”, Pearson 5. R. Gaikward, “Op amp and Integrated circuit”, 4 th Edition, Prentice Hall India Ltd		

DESIGN OF MACHINE ELEMENT LAB

COURSEOUTLINE

Course Title:	Design of Machine Element	Short Title:	DOME	Course Code:	

Course Description:

This course aims to equip the mechanical engineering students with the fundamentals of design activities and give them necessary skills to prepare complete, concise, and accurate calculation steps for machine elements. While the first part of the machine elements covering general stress analysis, failure conditions, shaft, spring, permanent and nonpermanent joints design, rolling contact and journal bearings, gears, clutches, flywheels, etc.

Laboratory	Hours/week	No. of weeks	Total hours	Semester Credits
	02	14	28	01

Pre-requisite Course(s):

The sound knowledge of Mathematics (Calculus), Engineering Mechanics, SOM and TOM subjects

Course Objectives:

1. To study the basic design principles
2. To familiarize with use of design data books & various codes of practice
3. To make conversant with preparation of working drawings based on designs

Course Outcomes:

After successfully completion of this course students will be able to:
1. design shaft under various conditions
2. design Coupling
3. design Permanent Joints and Temporary Joints
4. design Leaf spring
5. convert design dimensions into working/manufacturing drawing and use of design data book/standard codes to standardize the designed dimensions

COURSE CONTENT

Design of Machine Element Lab		Semester:	VII
Teaching Scheme:		Examination Scheme:	
Practical:	02 hours/week	End Semester Exam (ESE): oral	25 marks
		Internal Continuous Assessment (ICA):	25 Marks

Term work - Shall consist of

A. Design and detailed assembly drawing (computer aided drawing) of minimum two design problems, from the following.

1) Flexible flange coupling 2) Leaf spring 3) Spur Gear Box 4) Helical Gear Box 5) Worm Gear Box

B. Assignment: Design exercises in the form of design calculations with sketches and/ or drawings.

C. Course Project: Students in a group of two to four will be able to design and prepare working drawings (using any software) of any system having minimum 5 to 6 components by applying the knowledge gained during the course

Text Books:
1. Bhandari V.B., "Design of Machine elements", Tata McGraw Hill Pub. Co. ltd. 2. Farzdak Haideri, "Machine Design", Nirali Prakashan, Pune 3. R. B. Patil, "Mechanical System Design" Techmax publications, 4th edition (2018)
Reference Books:
1. Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill Pub. Co. Ltd 2. Spott's M.F. and Shoup T.E. "Design of Machine Elements", Prentice Hall International. 3. "Design Data", P.S.G. College of Technology, Coimbatore. 4. Juvinal R.C. "Fundamental of Machine Component Design", John Wiely and sons. 5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998
Guidelines for ICA:
Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

AUTOTRONICS LAB					
COURSE OUTLINE					
Course Title:	**Autotronics Lab**		**Short Title:**	AL	**Course Code:**
Course description:					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Lecture	01	14	14	02
Practical	02	14	28	

Prerequisite course(s):

Course objectives:

1. To present a problem oriented in depth knowledge of Autotronics
2. To address the underlying concepts and methods behind Autotronics

Course outcomes:

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

1. The student can identify different areas of Autotronics
2. Can find the applications of all the areas in day to day life.

COURSE CONTENT

Autotronics Lab		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**1 hours/week**	**End Semester Exam (ESE): Practical**	**25 Marks**
		Internal Continuous Assessment (ICA):	**25 Marks**

Unit–I:	**No. of Lectures: 03 Hours**

. Fundamentals of Automotive Electronics: Microprocessor and micro Computer applications in automobiles; components for engine management System; electronic management of chassis system; vehicle motion control; electronic panel meters.

Unit–II:	**No. of Lectures: 02 Hours**

Sensors & Actuators: Introduction; Basic sensor arrangement; Types of Sensors such as oxygen sensors, Crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow Sensors, throttle position sensors, solenoids, stepper motors, relays

Unit–III:	**No. of Lectures: 03 Hours**

Electronic Fuel Injection & Ignition System: Introduction; feedback carburetor system; throttle body injection and multi point fuel injection System; injection system controls; advantage of electronic ignition systems; types of solid-state system and their principle of operation; electronic spark timing.

Unit–IV:	**No. of Lectures: 03 Hours**

Digital Engine Control System: Open loop and closed loop control system; engine cooling and warm-up control; acceleration, deceleration and idle speed control; integrated engine control system; exhaust emission control engineering; on-board diagnostics; future automotive electronic systems.

Unit–V:	**No. of Lectures: 03 Hours**	
Automotive Electrical: Batteries; starter motor & drive mechanism; D.C. generator and alternator; regulation for charging; lighting design; dashboard instruments; horn, warning system and safety devices		
List of Practical's: Teacher should facilitate following lab experiments: 1. Demonstration and testing of auto electrical components on multifunction tester 2. Demonstration of head light aiming apparatus 3. Demonstration of dashboard panel instruments and control. 4. Study of throttle position sensor/ lambda sensor 5. Study of EGR valve control in electronically controlled systems. 6. Study of multi point fuel injection system 7. Study of Electric power steering. 8. Study of Electronic Stability control system. Note: Lab file should contain at list six experiments from above mentioned list.		
Text Books:		
1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004. 2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition. 3. William Harry Crouse, "Automotive Electronics and Electrical Equipment", Edition 10, Gregg Division, McGraw-Hill, 1986, ISBN 0070148953, 9780070148956		
Reference Books:		
1. William Harry Crouse, Donald L. Anglin, "Automotive Tune up", Automotive Technology Series, Publisher McGraw-Hill Gregg Division, 1977. 2. Ken Layne, "Automobile Electronics and Basic Electrical Systems", Volume 1, Wiley, 1989.		
Guidelines for ICA:		
Students must submit ICA in the form of journal.		
Guidelines for ESE: (Practical)		
The Practical Examination will comprise of performing the experiment.		

Project (Stage – I)					
LAB COURSE OUTLINE					
Course Title:	**Project (Stage – I)**	**Short Title:**	**PROJ-SI**	**Course Code:**	
Course description:					
Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	12	**14**	**168**	**6**	
End Semester Exam (ESE) Pattern:	**Oral (OR)**				
Prerequisite course(s):					
Course objectives:					
1. To understand the basic concepts & broad principles of projects. 2. To understand the value of achieving perfection in project implementation & completion. 3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach. 4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Demonstrate a sound technical knowledge of their selected project topic. 2. Undertake problem identification, formulation and solution. 3. Design engineering solutions to complex problems utilizing a systems approach. 4. Conduct an engineering project 5. Demonstrate the knowledge, skills and attitudes of a professional engineer.					
LAB COURSE CONTENT					
Project (Stage – I)		**Semester:**		**VII**	
Teaching Scheme:		**Examination Scheme:**			
Practical:	**12 hours/week**	**End Semester Exam (ESE): OR**		**50 marks**	
		Internal Continuous Assessment (ICA):		**50 marks**	
At the final year the students shall carry out a project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester –VII the students shall complete the partial work, and by the end of Semester –VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects. The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI and/or during Internship. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department. The work may also be					

Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship.

Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design and analysis. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of spiral bound at the end of Semester –VII. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract
Chapter 1. Introduction

Chapter 2. Project Planning and Management

Chapter 3. Literature Review

Chapter 4. Research Gap, Problem Statement and Objective

Chapter 5. Conclusion

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (Stage – I) in Semester – VII shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:
In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge					
COURSE OUTLINE					
Course Title:	**Essence of Indian Traditional Knowledge**	**Short Title:**	**EITK**	**Course Code:**	
Course description:					

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	-----	14	-----	1

Prerequisite course(s):

Course objectives:

The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Course outcomes:

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

1. understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.
2. adopt traditional methods of Ayurveda and Yoga for happy and healthy life
3. practice classical music and dance
4. understand about ancient architecture

COURSE CONTENT

Essence of Indian Traditional Knowledge		Semester:	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	-----	**End semester exam (ESE):**	----
		Duration of ESE:	----
		Internal Sessional Exams (ISE):	----

Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.
   5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

Reference Books:

1. Amit Jha, "Traditional knowledge system in India", Atlantic Publisher, ISBN 978812691223
2. Basanta Kumar Malhotra, "Traditional Knowledge System and Technology in India", Pratibha Prakashan, ISBN 8177-023101
3. Nitin Singhania, "Indian Art and Culture", McGraw Will Publication.
4. Dr. Bramhand Tripathi, "Charak Sanhita", Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
5. Dr. Anantram Sharma, "Sushrut Samhita"
6. Valiatham M.S., "An Introduction to Ayurveda" Orient Bkackswan Publication.
7. Valiathan M.S., "The legacy of Charaka" University Press.
8. Valiathan M.S., "The legacy of Susruta" University Press.
9. Garg Maheshwari, "Ancient Indian Architecture", CBS Publisher and Distributors
10. Sharmin Khan, "History of Indian Architecture", CBS Publisher and Distributors.
11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, "Introduction to Indian Architecture", Periplus Editions Ltd.
12. Vijay Prakash Singh, "An Introduction to Hindustani Classical Music", Lotus Publisher
13. Leeta Venkataraman, Avinash Pasricha, "Indian Classical Dance" Lustre Publisher
14. Shovana Narayan, "Indian Classical Dances" New Dawn Press
15. Kapila Vatsyayan, "Indian Classical Dance", Ministry of Information and Broadcasting, Govt of India.
16. Mahadevan Ramesh, "A Gentle introduction to Carnatic Music", Oxygen books Publisher.

Kavayatri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering (Automobile Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

Syllabus Structure & Contents of Fourth Year of Engineering

Semester-VIII

w.e.f. 2020 – 2021

AUTOMOBILE SYSTEM DESIGN					
COURSEOUTLINE					
Course Title:	**Automobile System Design**	**Short Title:**	**VTE**	**Course Code:**	
Course Description:					
Subject is designed to provide understanding about the various parts of the automobile systems					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s):
Automobile Services
Course Objectives:
To make student get acquainted with to standardize the automobile part after designing the system component like clutch, propeller shaft, axle, steering linkages, braking parts, suspension system etc. within the space limitations and optimize it.
Course Outcomes:
After successfully completion of this course students will be able to:
1. Develop the engineering model with respect to aesthetic and ergonomic consideration. 2. Apply design technique to formulate and solve structural and design problems.

COURSE CONTENT

Automobile System Design		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Design of Piston and Connecting Rod	**No. of Lectures: 09 hours**	**Marks: 12**
a. Material Selection, Construction of Piston, Types of Piston, Manufacturing Process b. Design of Piston, Design of Piston Pin, Design of Piston Rings c. Material Selection and Construction of Connecting Rod, Types of Connecting Rod, Manufacturing Process d. Design Calculation of Split Type Connecting Rod and Its Drawing		

Unit – II: Design of Crank Shaft and Flywheel	**No. of Lectures: 09 hours**	**Marks: 12**
a. Material Selection, Construction of Crank Shaft, Types of Crank Shaft, Manufacturing Process, Design Calculation and Drawing b. Material Selection & Construction of flywheel, types of Flywheel, Manufacturing Process, Design Calculation And Drawing.		

Unit – III: Design of Cam Shaft, Valve operating Mechanism	**No. of Lectures: 08 hours**	**Marks: 12**
a. Material Selection & Construction of Cam Shaft, Types of Cam Profile b. Manufacturing Processes Design for - 1. Tangent Cam 2. Generated Cam Design Calculation & Drawing c. Calculation & Drawing of Valve Operating Mechanism Like Rocker Arm, Valves & Springs.		
Unit – IV: Design of Drive Line	**No. of Lectures: 08 hours**	**Marks: 12**
a. Design of Propeller Shaft & Universal Joint & Material Selection b. Design of Differential c. Numerical Problems On Steering Systems d. Design Of Front & Rear Axles.		
Unit – V: Statistical Consideration in Design	**No. of Lectures: 08 hours**	**Marks: 12**
a. Statistics Consideration in Design, Statistics in Design b. Design for Natural Tolerance, Statistical Analysis, Mechanical Reliability. c. Introduction to optimum design to mechanical element, adequate & Optimum Design d. Johnsons Method of Optimum Design, Simple Problems in Optimum Design		
Text Books:		
1. V.B.Bhandari, “Design of machine element”, Tata Mc Graw Hill, New Delhi. 2. J.S.Arora, “Introduction to optimum design”, Mc Graw Hill Book Company. 3. R.B.Gupta, “Auto Design”, Satya Prakashan, Delhi.		
Reference Books:		
1. Joseph E Shigley & Larry D. Mitchell, “Mechanical Engg. Design”, Mc- Graw Hill International Book Company. 2. M. F. Spotts & T. E. Shout, “Design of machine element” (7th Edition), Tata Mc Graw Hill, New Delhi. 3. R. C. Johnson, “Optimum design of mechanical element”, John Willey & Sons.		

NOISE, VIBRATION & HARSHNESS IN AUTOMOBILE					
COURSEOUTLINE					
Course Title:	**Noise, Vibration & Harshness in Automobile**	**Short Title:**	**VTE**	**Course Code:**	

Course Description:

This course will give knowledge about the sources, effects, prediction, control techniques, measurement techniques of noise, vibration pertain to an automobile.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s):

Course Objectives:

This course will give knowledge about the sources, effects, prediction, control techniques, measurement techniques of noise, vibration pertain to an automobile.

Course Outcomes:

After successfully completion of this course students will be able to:

1. know the basic of vibration and noise
2. Understanding the effect of noise on human comfort and environment
3. Know the methods of vibration and noise measurement.

COURSE CONTENT

Noise, Vibration & Harshness in Automobile		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Introduction to NVH & Vibration Analysis

a. Noise, Vibration and Harshness (NVH) and its role in automotive design and development
b. Physiological effects of noise and vibration, sources of vibration and noise in automobiles.
c. Basics of Vibration Analysis - Basic concepts, mathematical models, formulating the equations of motion - linear and torsional system characteristics and response
d. Damped and undamped single & two degree of freedom systems under harmonic force, coordinate coupling, generalized coordinates and modal analysis

Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**

Vibration Control Techniques

a. Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments
b. Applications: isolation of the engine from vehicle structure and control of torsional oscillation amplitudes in engine crankshaft

Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**

Noise Fundamentals

a. Fundamentals of acoustics – general sound propagation – structure borne sound & air borne sound, Plane wave propagation - wave equation

b. Specific acoustic impedance, acoustic intensity, Spherical wave propagation – acoustic near and far fields, Reference quantities

c. The decibel scale, relationship among sound power, sound intensity and sound pressure level, summation of pure tones

d. Decibel addition, subtraction and averaging, Effects of reflecting surfaces on sound propagation, octave band analysis

e. Anatomy of Human Ear, Mechanism of hearing, loudness, weighting networks, equivalent sound level.

Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**

NVH Measurements

a. Vibration and Noise Standards – Pass/Drive by noise, noise from stationary vehicles, interior noise in vehicles.

b. NVH measurement tools and techniques, Modal parameter (natural frequency, mode shape and damping) estimation techniques, signal and system analysis

Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**

Automotive Noise Sources and Control Techniques

a. Methods for control of engine noise, Transmission Noise, Intake and Exhaust Noise

b. Aerodynamic Noise, Tyre Noise, Brake noise

c. Noise control strategy, noise control at source – along the path isolation, damping, balancing, resonators, absorption, barriers and enclosures.

Text Books:

1. Bell, L. H. and Bell, D. H., "Industrial Noise Control – Fundamentals and Applications", Marcel Dekker Inc, New York, 1994

2. Ambekar, A. G., "Mechanical Vibrations and Noise Engineering", Prentice Hall of India, New Delhi, 2006.

3. Beranek, L. L. and Ver, I, L., "Noise and Vibration Control Engineering – Principles and Application", John Wiley & Sons, Inc, 1992

4. Wilson, C. E., "Noise Control – Measurement, Analysis, and Control of Sound and Vibration", Harper & Row Publishers, New York, 1989

5. Thomson, W. T., "Theory of Vibrations with Applications", CBS Publishers Delhi

Reference Books:

1. Norton, M.P., "Fundamentals of Noise and Vibration Analysis for Engineers", Cambridge University Press, Cambridge, 2003.

2. Irwin, J. D. and Graf, E. R., "Industrial Noise and Vibration Control", Prentice Hall, Englewood Cliffs, New Jersey

3. Kewal Pujara "Vibrations and Noise for Engineers, Dhanpat Rai & Sons, 1992

4. Moser, M., "Engineering Acoustics – An Introduction to Noise Control", Springer, Indian Edition, 2009

5. Matthew Harrison, "Vehicle Refinement – Controlling Noise and Vibration in Road Vehicle", Butterworth-Heinemann, Indian Edition,2011

6. Smith, J. H., "An Introduction to Modern Vehicle Design", Butterworth Heinemarm, 2002

ELECTRICAL AND HYBRID VEHICLES

COURSEOUTLINE

Course Title:	Electrical and Hybrid Vehicles	Short Title:	EHV	Course Code:	

Course Description:

This course will provide you with a broad technical knowledge and practical expertise of hybrid and electric vehicle (HEV) technologies, analysis, design, component selection and sizing at both system and vehicle level.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

Basics of electrical and electronics engineering, Control Systems Engineering, Electrical Machines

Course Objectives:

1. To study the concepts and drive train configurations of electric drive vehicles
2. To provide different electric propulsion systems and energy storage devices
3. To explain the technology, design methodologies and control strategy of hybrid electric vehicles
4. To emphasize battery charger topologies for plug in hybrid electric vehicles

Course Outcomes:

After successfully completion of this course students will be able to:

1. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
2. Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
3. Choose proper energy storage systems for vehicle applications.
4. Identify various communication protocols and technologies used in vehicle networks.
5. Understand energy management strategies.

COURSE CONTENT

Electrical and Hybrid Vehicles		Semester:	VII
Teaching Scheme:		Examination Scheme:	
Lectures:	3 hours/week	End Semester Exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit – I:	No. of Lectures: 09 hours	Marks: 12

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit – II:	No. of Lectures: 09 hours	Marks: 12

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives. Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies		
Text Books:		
1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011. 2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.		
Reference Books:		
1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010. 2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000 3. http://nptel.ac.in/courses/108103009/		

SPECIAL PURPOSE VEHICLE					
COURSEOUTLINE					
Course Title:	**Special Purpose Vehicle**	**Short Title:**	**SPV**	**Course Code:**	
Course Description:					
This course introduces undergraduate students to imparting knowledge of Special Purpose Vehicle.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s):
Automobile Systems
Course Objectives:
The course is designed to give knowledge of various special purpose vehicles existing systems and their applications in the present context.
Course Outcomes:
After successfully completion of this course students will be able to:
understand types, special feature, design, working principle of special purpose vehicles.

COURSE CONTENT			
Special Purpose Vehicle		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Heavy Machinery	**No. of Lectures: 09 hours**	**Marks: 12**
a. Introduction: - General classification & application of earth moving machinery in open cast mining & other places. Operations involved in such application b. Constructional & working features of different types of earth moving machinery, such as drills, rippers, shovels, wheel loaders, lifts, tractors, brake vehicles, Excavators, Dampers, Dozers, Cranes, Crushers, Feeders & compressors.		
Unit – II: Automobile System	**No. of Lectures: 09 hours**	**Marks: 12**
a. Study of working principles & design considerations of different systems involved like power systems, Transmission, Final drive, Lubrication, electrical, braking, steering & pneumatic & hydraulic control circuits b. Study of instrumentation applied to such machines		
Unit – III: Intra-plant transporting & Equipment	**No. of Lectures: 08 hours**	**Marks: 12**
a. Intra-plant transporting & handling equipment: - Types & principles groups of materials handling equipment, choice of hoisting equipments surface & overhead equipments.		

b. Components & theory of Hoisting equipments: - Chains & ropes, Pulleys socket drums, load handling attachments, arresting gear & brakes.		
Unit – IV: Vehicle Drives & Cranes	**No. of Lectures: 08 hours**	**Marks: 12**
a. Drives: - Hand drive & operating levers, Power driver, hoisting mechanisms traveling gear slowing, jib & lifting gears. b. Mobile Cranes: - Basic characteristic of truck cranes, stability & design features, control systems & safety devices.		
Unit – V: Elevators	**No. of Lectures: 08 hours**	**Marks: 12**
a. Elevators: - Cage elevators, portable air operated hoist, portable hydraulic jacks, car lift, stackers, handling & safety. b. Battery operated electric vans: - principles of operation, special features.		
Text Books:		
1. N. Rudenko," Material Handling Equipments", M.R. Publishers 2. "Truck Cranes", M.R. Publishers 3. Sheldon, R. "Shacket, Electric Vehicles", Domus Book, New York		
Reference Books:		
1. Y.Fokras & M. Tushnyakov, "Construction Equipments operation & maintenance", (MIR Mosco.) 2. A. Astskhov ,"Truck cranes ", (MIR) 3. E.G. Poninson ,Motor Grader , (MIR		

VEHICLE SAFETY TECHNOLOGY

COURSEOUTLINE

Course Title:	Vehicle Safety Technology	Short Title:	VST	Course Code:	

Course Description:

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

Course Objectives:

The course will give student a good exposure about automotive safety aspects including the understanding of the various safety equipment's.

Course Outcomes:

After successfully completion of this course students will be able to:
understand various systems that enhances vehicle safety, passenger comfort, recent technologies in automobile field etc.

COURSE CONTENT

Vehicle Safety Technology		Semester:	VII
Teaching Scheme:		Examination Scheme:	
Lectures:	3 hours/week	End Semester Exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit – I: Introduction	No. of Lectures: 09 hours	Marks: 12

a. Design of the body for safety, energy equation, engine location.
b. Deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle.
c. Concept of crumble zone, safety sandwich construction.

Unit – II: Safety Concepts	No. of Lectures: 09 hours	Marks: 12

a. Active safety: driving safety, conditional safety, perceptibility safety, operating safety
b. Passive safety: exterior safety, interior safety
c. Deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

Unit – III: Safety Equipments	No. of Lectures: 08 hours	Marks: 12

a. Seat belt, regulations, automatic seat belt tightener system.
b. Collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags.
c. Bumper design for safety.

Unit – IV: Collision warning and avoidance	**No. of Lectures: 08 hours**	**Marks: 12**
a. Collision warning system, causes of rear end collision. b. Frontal object detection, rear vehicle object detection system. c. Object detection system with braking system interactions		
Unit – V: Comfort and convenience system	**No. of Lectures: 08 hours**	**Marks: 12**
a. Steering and mirror adjustment, central locking system b. Garage door opening system, tyre pressure control system. c. Rain sensor system, environment information system		
Text Books:		
1. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011. 2. Powloski. J., "Vehicle Body Engineering", Business books limited, London, 1969.		
Reference Books:		
1. Ronald.K.Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 1999		

AUTOMOTIVE MATERIALS					
COURSEOUTLINE					
Course Title:	**Automotive Materials**	**Short Title:**	**AM**	**Course Code:**	

Course Description:

This course introduces undergraduate students to imparting knowledge of Automotive Materials.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s):

Engineering Materials

Course Objectives:

1. To present a problem oriented in depth knowledge of Automobile materials and manufacturing
2. To address the underlying concepts and methods behind Automobile materials and manufacturing

Course Outcomes:

After successfully completion of this course students will be able to:
1. The student can identify different areas of automobile materials and manufacturing.
2. Can find the applications of all the areas in day to day life.

COURSE CONTENT

Automotive Materials		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Elasticity & Heat Treatment techniques:

Elasticity-forms - Stress and strain relationship in engineering materials - Deformation mechanism - Strengthening material - Strain hardening, alloying, polyphase mixture, martensitic precipitation

Dispersion, fiber and texture strengthening - iron carbon diagram, Strength and stiffness – failure modes – analysis of laminated composites – stress-strain variation in a laminate

Heat treatment of steel - Annealing - Types, normalizing, Types, hardening and tempering with specific relevance to automotive components, surface hardening techniques

Induction, flame and chemical hardening, coating of wear and corrosion resistance, Electroplating, Phosphating, Anodizing, hot dipping, thermal spraying, hard facing and thin film coatings

Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**

Selection of materials:

Criteria of selecting materials for automotive components viz Cylinder block, Cylinder head, Piston, Piston ring, Gudgeon pin, Connecting rod, Crank shaft, Crank case, Cam, Cam shaft, Engine valve
Gear wheel, Clutch plate, Axle, Bearings, Chassis, Spring, body panel - Radiator, Brake lining etc.
Application of non-metallic materials such as composite, ceramic and polymers in automobile

Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**

Material and Its Characteristics
Definition –Need – General Characteristics, Applications. Fibers, flake and particulate composites – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive. Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness.
Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding.

Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**

Manufacturing & testing methods:
Manufacturing methods: Production of various fibers – matrix materials and surface treatments – fabrication of composites – fabrication of thermosetting resin matrix Composites – fabrication of thermoplastic resin matrix composites – short fiber Composites – fabrication of metal matrix and ceramic matrix composites.
Testing aspects of composites: Experimental characterization of composites – uniaxial tension, compression and shear tests – determination of interlaminar fracture toughness damage identification through non-destructive evaluation techniques – ultrasonic, acoustic emission and X-radiography.

Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**

Special laminates:
Symmetric laminates, uni-directional, cross-ply and angle-ply laminates, quasi-isotropic laminates. Recent trends in composite materials – carbon composites
Bucky Papee. Application of composite materials in aerospace, automotive, defense and industry.
Mechanical behavior of UD composites: Longitudinal strength and stiffness – transverse strength and stiffness – failure modes – analysis of laminated composites – stress-strain variation in a laminate.

Text Books:

1. Khanna.O.P., "Material Science and Metallurgy ", Dhanapat Rai & Sons, 1992
2. B. D. Agarwal, L. J. Broutman, Analysis and Performance of Fibre Composites, John Wiley.
3. Kapoor, "Material Science and Processes ", New India Publishing House, 1987
4. Raghavan.V. Physical Metallurgy, Principle and Practice, Prentice Hall, 1995

Reference Books:

1. Dieter.G.E. Mechanical Metallurgy, McGraw Hill, New York, 1972.
2. Avner.S.H. Introduction to physical metallurgy, McGraw Hill, New York., 1982
3. R. F. Gibson, Principle of Composite Material Mechanics, McGraw Hill

4. M. M. Schwartz, Composite Materials Handbook, McGraw Hill. Inc
5. R. M. Jones, Mechanics of Composite Materials, McGraw Hill. Inc

HEAVY VEHICLES AND EARTH MOVERS					
COURSEOUTLINE					
Course Title:	**Heavy Vehicles and Earth Movers**	**Short Title:**	**HVEM**	**Course Code:**	

Course Description:

This course introduces undergraduate students to imparting knowledge of heavy vehicles and earth movers, their system and features.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

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Course Objectives:

This subject provides knowledge of repair and maintenance of tractors and earth moving machinery.

Course Outcomes:

After successfully completion of this course students will be able to:
understand types, special feature, design, working principle of heavy vehicles and earth movers

COURSE CONTENT

Heavy Vehicles and Earth Movers		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Classification & requirements of off road vehicles:
Construction layout, capacity and applications of off road vehicle.
Prime mover, chassis and transmission, Multiaxle vehicles.

Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**

Earth moving constructional machines:
Dumpers - safety features, safe warning system for dumper, Design aspects on dumper body. Articulated Dumpers, loaders - single bucket, Multi bucket and rotary types - bulldozers, kinematics for loader and bulldozers with operational linkages, excavators.
Backhoe loaders, scrappers, motor graders, power shawl, bush cutters, Bush cutters, stumpers, rippers.

Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**

Industrial applications:
Constructional and working details of Jib crane, concrete ready mixers

Compactors - vibratory compactors, forklift, utility vehicles, man - lift, scissors, lift trucks, Material handlers, power generators.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Farm equipments, military and combat vehicles: Tractors, classification - working attachments, power take off, special implements. Paddy harvester, sugarcane harvester, feller bunchers. Special features and constructional details of military tankers, AVLB gun carriers and transport vehicles.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Vehicle Systems, features: Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders Power steering system, Articulated steering assembly - power and capacity of earth moving machines.		
Text Books:		
1. Abrosimov. K., Bran berg. A, Katayer. K., "Road making machinery", MIR Publishers, Moscow, 1971. 2. Nakra C.P., “Farm machines and equipments” Dhanpat rai Publishing company Pvt. Ltd. 3. Robert L Peurifoy, “Construction, planning, equipment and methods” Tata McGraw Hill Publishing company Ltd. 4. SAE Handbook Vol. III., Society of Automotive		
Reference Books:		
1. Bart H Vanderveen, "Tanks and Transport Vehicles", Frederic Warne and Co Ltd., London.Ia. S. Ageikin, “Off the Road Wheeled and Combined Traction Devices: Theory and Calculation”, Ashgate Publishing Co. Ltd. 1988. 2. Schulz Erich.J, "Diesel equipment I & II", McGraw Hill company, London, 1982. 3. Satyanarayana. B., "Construction planning and equipment", standard publishers and distributors, New Delhi, 1985.		

ENTREPRENEURSHIP, INNOVATIONS & STARTUPS					
COURSE OUTLINE					
Course Title:	**Entrepreneurship, Innovations & Startups**	**Short Title:**	**EIS**	**Course Code:**	

Course Description:

This course is a comprehensive "deep dive" into the crucial law-sensitive issues faced in the launching, financing, growing, and selling or winding down a new venture.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

Communication Skills

Course Objectives:

1. Understanding the concept and process of entrepreneurship - its contribution in and role in the growth and development of individual and the nation
2. Acquiring entrepreneurial quality, competency and motivation
3. Learning the process and skills of creation and management of entrepreneurial venture

Course Outcomes:

After successfully completion of this course students will be able to:

1. Understand the meaning and define a startup
2. Understand the meaning and triggers of idea generation
3. Understand the values, attitudes and motivation required by an Entrepreneur
4. Understand and apply the concept of Business Plan
5. Understand the methods of raising finance in primary market & the importance of secondary market for mobilization or resources

COURSE CONTENT

Entrepreneurship, Innovations & Startup		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Business Models & Intellectual Property:

The Creative Process: Ideation, management of innovation, design thinking based on a particular technology.

Opportunity Identification and Research– opportunity seeking and identification, feasibility analysis, business model development, and understanding the needs of the customer and the market.

Strategy, Planning & Team Building – forming a venture or project team, introduction to creating business plans, legal and financial issues of starting and maintaining a new venture, strategic planning for a new product, issues around the commercialization of intellectual property and new technology transfer models.		
Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Design Thinking for Innovation: Structuring and Packaging a Commercial idea – The value propositions, sustainable positioning, competitive advantage, presenting the idea in multiple formats, formulating new product development timelines and analysing strategic options. Integrating Continuous Feedback and Communicating Concepts to Different Audiences – Obtaining and integrating key feedback from multiple mentors, constantly adjusting the relevant information into a variety of communications options and to ability to identify relevant gaps.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Entrepreneurship: Introduction to Entrepreneurship: Meaning and concept of entrepreneurship, the history of entrepreneurship development, role of entrepreneurship in economic development, agencies in entrepreneurship management and future of entrepreneurship. The Entrepreneur: Meaning of entrepreneur, the skills required to be an entrepreneur, the entrepreneurial decision process, and role models, mentors and support system		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Technology & Innovation Management: Business Opportunity Identification: Business ideas, methods of generating ideas, and opportunity recognition. Preparing a Business Plan: Meaning and significance of a business plan, components of a business plan, and feasibility study Launching the New Venture: Choosing the legal form of new venture, protection of intellectual property, and marketing the new venture.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Venture Capital & Growth Finance: Financing the New Venture: Importance of new venture financing, types of ownership securities, venture capital, types of debt securities, determining ideal debt-equity mix, and financial institutions and banks Managing Growth in New Venture: Characteristics of high growth new ventures, strategies for growth, and building the new venture capital Harvesting Rewards: Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.		
Text Books:		
1. Drucker, P. F. Innovation and Entrepreneurship: Principles and Practice 2. Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses 3. Muthu Singaram, "Entrepreneurship: A hands on guide to starting your business" 4. Prathistha Jain, Muthu Singaram, "Greenfields: Building a Stronger Ecosystem for Start-Ups and Entrepreneurs: Suggested Standard Operating Procedures for Incubators".		

Reference Books:
1. Osterwalder, A. and Pigneur, Y., "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers". 2. Thiel, P., "Zero to One: Notes on Startups, or How to Build the Future" 3. Christenson, Clayton, "The Innovator's Dilemma",

MECHATRONIC SYSTEMS

COURSEOUTLINE

Course Title:	Mechatronic Systems	Short Title:	MS	Course Code:	

Course Description:

Mechatronics is a multi-disciplinary study dealing with the integration of mechanical devices, actuators, sensors, electronics, intelligent controllers and computers. Many new generations of consumer or commercial products can be classified as mechatronic products as they involve mechanical as well as electronic components.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

The sound knowledge of Mathematics (Calculus), Engineering Mechanics, SOM and TOM subjects

Course Objectives:

(i) To understand the structure of microprocessors and their applications in mechanical devices
(ii) To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators
(iii) To understand the use of micro-sensors and their applications in various fields

Course Outcomes:

Upon completion of this course, students will be able to:
1. Understand how different physical variables are measured and illustrate their working principles
2. Identify and select proper sensors and transducers for specific applications
3. Understand issues of implementation of MEMS & Touch sensors
4. Understand different types of actuators and their implementation
5. Design the pneumatic and hydraulic system.

COURSE CONTENT

Mechatronic Systems		Semester:	VII
Teaching Scheme:		Examination Scheme:	
Lectures:	3 hours/week	End Semester Exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit – I: Fundamentals of Mechatronics	No. of Lectures: 08 hours	Marks: 12

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach. Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology

Unit – II: Sensors and Transducers	No. of Lectures: 08 hours	Marks: 12

Introduction, Significance of Sensor Measurements, Classification of Sensors, Analog vs Digital Sensors

Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc.

Dynamic Characteristics: Sensor bandwidth and frequency response

Signal conditioning: Amplifier, Conversion, Filtering, Impedance Buffering Types of errors, Effect of component errors, Probable errors. Selection criteria of sensors for mechatronic systems. Sensors**:** Displacement and Position Sensors, Velocity, Force, Motion and Pressure Sensors, Temperature and Light Sensors,

Unit – III: MEMS and Touch sensors	**No. of Lectures: 08 hours**	**Marks: 12**

MEMS Sensors: Micro Electro Mechanical System (MEMS) Sensors, Working Principle, MEMS accelerometers, MEMS gyroscopes, MEMS pressure sensors, MEMS magnetic field sensors, Advantages, Applications, Air Bag Crash Sensors, Antilock Brake System, Active Suspension System,

Touch Sensors: Working Principle, capacitor Type Touch Sensors, Resistive Touch sensors, Applications,

Unit – IV: Drives and Controls	**No. of Lectures: 09 hours**	**Marks: 12**

Stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems. open and closed loop control; Embedded Systems, Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.

Unit – V: Hydraulic & Pneumatic system	**No. of Lectures: 09 hours**	**Marks: 12**

Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits.

Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems.

Smart materials: Shape Memory Alloy, Piezoelectric and Magneto strictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.;

Text Books:

1. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and Hall, 1996.
2. HMT ltd. Mechatronics, Tata Mc graw Hill, New Delhi, 1988
3. Deb,S. R., Robotics technology and flexible automation, Tata McGraw-Hill, New Delhi, 1994.
4. Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore, 1999.
5. A Textbook of Mechatronics, R. K. Raput, S. Chand Publishing
6. Mechatronics: Principles, Concepts and applications, Mahalik N.P, Tata McGraw Hill

Reference Books:

1. Introduction to Mechatronics, Kuttan, Oxford University
2. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

3. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)

ROBOTICS					
COURSE OUTLINE					
Course Title:	**Robotics**	**Short Title:**	**RBT**	**Course Code:**	
Course Description:					
This course is aimed to provide exposure on the Robot anatomy, sensors, kinematics, applications and problems associated with their design.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):

Fundamental knowledge of Mathematics, Automation, Mechatronics.

Course Objectives:

1) To understand the basic concepts associated with the robot functioning and applications of Robots.
2) To study about the robot motion analysis of robot.
3) To study about the drives and control system used in Robots.
4) To understand the concepts of end effectors, sensors and vision system used in robots
5) To learn about robot programming

Course Outcomes:

After successfully completion of this course students will be able to:

1) To know about fundamental knowledge about the robot
2) To know about robot motion analysis
3) To know about drives and control system used in robots.
4) To know about end effectors, sensors and vision system.
5) To know about robot programming methods and languages.

COURSE CONTENT

Robotics		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

BASIC CONCEPT IN ROBOTICS

Historical perspective of robot, definition of robot, need of robots, classification of robot, automation and robotics, robot anatomy, basic structure of robotics. resolution, accuracy and repeatability, Classification of configuration of robot, point to point and continuous system, control loop of robotics system, Points considered for Selection of Robot, Degree of Freedom of robot, comparison of the human and robot manipulator, Robot joints, Application of robot.

Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**

ROBOT MOTION ANALYSIS

Introduction, Robot arm kinematics, Transformations, rotation matrix, geometric interpretation of rotation matrix, inverse transformation, composite transformation, Kinematics chain, Forces encountered in Moving coordinate systems Lagrange's Analysis of Manipulator.

Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**

DRIVES AND CONTROL SYSTEM

Robot drive system, Hydraulic system for robot, Pneumatic actuators, Electric drives DC servo motor, AC servo motor, stepper motor, Robot activation and feedback component, positional and velocity sensors. power transmission system, Application of robot.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
END EFFECTORS, SENSORS AND VISION SYSTEMS		
End Effectors Types of end effectors, mechanical grippers, vacuum, magnetic, adhesive grippers, tools as end effectors, Gripper selection and design, force analysis of gripper mechanism, Introduction to Sensors: Need of sensors in a robotic system, selection of sensors, classification of sensor, photo sensors, limit switches. Range sensors, force/ torque sensors, proximity sensors, touch sensors, tactile sensors. VISION SYSTEMS: concept of low level and high-level vision in a robotic system.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
ROBOT PROGRAMMING		
Methods of robot programming, On line Programming, Teach Pendant Programming, Walk through Programming, off line programming and lead through programming methods, a robot program as a path in space. Motion interpolation WAIT, SIGNAL, AND DELAY commands. ROBOT LANGUAGES: The textural robot languages, generation of robot programming languages, robot language structure, constant, variables and other. data objects, motion commands, end effector and sensor commands		
Text Books:		
1.Industrial Automation and Robotics by A. K. Gupta & S. K. Arora 2. Industrial Robotics by Ganesh S. Hedge 3. CAD/CAM & Automation by R. B. Patil		
Reference Books:		
1) Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002 2) Groover," Industrial Robotics", McGraw Hill Publication Co. Ltd 3) John J. Craig, "Introduction to Robotics Mechanics and Control", Pearson Education Inc., 4) M. P. Groover, "Industrial Robotics - Technology, Programming and Applications" 5) Niku, "Introduction to Robotics: Analysis System and Application", Pearson Education		

AUTOMOBILE SYSTEM DESIGN LAB

COURSE OUTLINE

Course Title:	Automobile system design lab	Short Title:	ASDL	Course Code:

Course Description:

Subject is designed to provide understanding about the various parts of the automobile systems

Practical	Hours/week	No. of weeks	Total hours	Semester Credits
	2	14	28	01

Pre-requisite Course(s): Mathematics, Computational Methods, Design, Vibration, SOM etc.

Course Objectives:

To make student get acquainted with to standardize the automobile part after designing the system component like clutch, propeller shaft, axle, steering linkages, braking parts, suspension system etc. within the space limitations and optimize it.

Course Outcomes:

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

1. Develop the engineering model with respect to aesthetic and ergonomic consideration.
2. Apply design technique to formulate and solve structural and design problems.

COURSE CONTENT

Automobile system design lab		Semester:	VIII
Teaching Scheme:		Examination Scheme:	
		End Semester Exam (ESE): Oral	25 marks
Practical's:	2 hours/week	Internal Continuous Assessment (ICA):	25 marks

(Any 6 Practical) Consists of minimum Four Trial Practical.

1) It shall consist of two A-2 size sheets based on design of any one system mentioned below: Piston connecting rod assembly, Propeller shaft & Universal joint, Front axle, Rear axle, Cam & valve actuating mechanism.
2) Components drawing of the above assembly in A-2 size sheet.
3) Three assignment based on curriculum of this course.

Text Books:

1. V. B. Bhandari, "Design of machine element", Tata Mc Graw Hill, New Delhi.
2. J. S. Arora, "Introduction to optimum design", Mc Graw Hill Book Company.
3. R. B. Gupta, "Auto Design", Satya Prakashan, Delhi.

Reference Books:

1. Joseph E. Shigley & Larry D. Mitchell, "Mechanical Engg. Design", Mc Graw Hill International Book Company.
2. M. F. Spotts & T. E. Shout, "Design of machine element" (7th Edition), Tata Mc Graw Hill, New Delhi.
3. R. C. Johnson, "Optimum design of mechanical element", John Willey & Sons.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE: (Oral)

ESE will be based on the laboratory assignments submitted by the students in the form of journal. Evaluation will be based on the understanding and quality of lab work.

FINITE ELEMENT ANALYSIS AND SIMULATION TECHNIQUE LAB

COURSE OUTLINE

Course Title:	**Finite Element Analysis & Simulation Technique**	**Short Title:**	**FEAST**	**Course Code:**

Course Description:

This course introduces undergraduate students to Finite Element Analysis and Simulation Technique. The background required includes a sound knowledge of Mathematics, Strength of materials and Machine Design. The course aims at imparting knowledge of Finite Element Analysis and Simulation Technique.

	Hours/week	**No. of weeks**	**Total hours**	**Semester Credits**
Lecture	**2**	**14**	**28**	**03**
Practical	**2**	**14**	**28**	

Pre-requisite Course(s): Mathematics, Computational Methods, Design, Vibration, SOM etc.

Course Outcomes:

After successfully completion of this course students will be able to:

1. understand the basic finite element formulation techniques.
2. derive equations in finite element methods for 1D problems.
3. derive equations in finite element methods for 2D problems.
4. derive equations in finite element methods for 3D problems.
5. understand the basic concept of Simulation and its techniques

COURSE CONTENT

Finite Element Analysis and Simulation Technique Lab		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**2 hours/week**	**End Semester Exam (ESE): Practical:**	**25 marks**
Practical's:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Unit – I:	**No. of Lectures: 04 hours**	

Introduction to Finite Element Method

Introductory Concepts: Introduction to FEM, Discretization going from part to whole approach, Physical problem, mathematical models and finite element solution, FEA as a integral part of CAD, Steps used in Finite Element Method, FEM Software's - Pre-processing, processing and post processing. Advantages and disadvantages of FEM, Types of Finite Elements.

Unit – II:	**No. of Lectures: 07 hours**	

One Dimensional Analysis

Discretization of one-Dimensional element, matrix analysis method, Derivation of Shape functions, element stiffness matrices, global stiffness matrix, application of boundary, and force vectors.

Assembly of Matrices - solution of problems in one dimensional structural analysis, Stepped and Taper Bars, Torsion of circular shaft.		
Unit – III:	**No. of Lectures: 07 hours**	
Two-Dimensional Analysis		
Introduction. Finite element analysis for truss element. Natural coordinates and coordinates transformations, Derivation of shape functions for triangular element. Analysis of structural vibration. Finite element formation of beams.		
Unit – IV:	**No. of Lectures: 06 hours**	
Two-Dimensional Vector Variable Problems		
Equations of elasticity – Plane stress, plane strain problems, Applications to free vibration problems of rod and beam. Lumped and consistent mass matrices, Jacobian matrix, stress analysis of CST element, eigen value Problems.		
Unit – V:	**No. of Lectures: 04 hours**	
Simulation Theory		
Simulation: Introduction, definition, steps used in simulation, advantage and limitations, techniques of simulation. **System models and studies:** - concepts of a system, system environment, stochastic activities, continuous and discrete systems, system modelling, types of models, principles used in modelling, types of system studies, comparison of simulation and analytical methods, analogue computers and methods, hybrid computer		
Outline of Content: This course contains: A. 1. Analysis of I-cantilever beam. 2. Analysing Flow in a System of Pipes. 3. Analysis of Trusses. 4. Modal Analysis of Spring-Mass System. 5. Modal Analysis of continuous System. 6. Thermal analysis of any component. 7. Stress strain analysis of any component. 8. Kinematic Analysis and simulation of slider crank Mechanism. B. Three assignments on syllabus **Note:** Lab file should contain any five experiments by using any analysis software.		
Text Books:		
1. CAD/CAM and Automation by R. B. Patil, Tech max publication. 2. J.N. Reddy, an Introduction to Nonlinear Finite Element Analysis, OUP. 3. C.S. Krishnamoorthy., Finite element analysis TMH 4. J.N. Reddy, Finite element methods, McGraw hill publication ltd.		
Reference Books: 1. Robert Cook, “Concept an application of Finite element analysis” 2. Klaus-Jurgen Bhate, “Finite element analysis”, PHI 3. C.S. Desai and J.F. Abel, “Introduction to finite element methods”, CBS 4. Tirupati R. Chandrupatla, “Finite element analysis” PHI. 5. Geoffery Gordon, “System simulation”		

6. Narsingh Deo, “System simulation with digital computers” 7. Kenneth Lt. Huebner, “The FEM for Engineers”, Wiley India Pvt. Ltd. New Delhi
Guidelines for ICA:
Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.
Guidelines for ESE: (Practical)
ESE will be based on experiments performed & submitted by the students in the form of journal. Evaluation will be based on the understanding and quality of lab work.

PROJECT					
LAB COURSE OUTLINE					
Course Title:	**Project**	**Short Title:**	**PROJ**	**Course Code:**	
Course description:					
Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	6	**14**	**84**	**3**	
End Semester Exam (ESE) Pattern:	**Oral (OR)**				
Prerequisite course(s):					
Course objectives:					
1. To understand the basic concepts & broad principles of projects. 2. To understand the value of achieving perfection in project implementation & completion. 3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach. 4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Demonstrate a sound technical knowledge of their selected project topic. 2. Undertake problem identification, formulation and solution. 3. Design engineering solutions to complex problems utilizing a systems approach. 4. Conduct an engineering project 5. Demonstrate the knowledge, skills and attitudes of a professional engineer.					
LAB COURSE CONTENT					
Project		**Semester:**	**VIII**		
Teaching Scheme:		**Examination scheme:**			
Practical:	**6 hours/week**	**End semester exam (ESE): (OR)**	**50 marks**		
		Internal Continuous Assessment (ICA):	**50 marks**		
In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the students should complete implementation of ideas as formulated in Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound. Assessment for the project shall also include presentation by the students. Each student group is required to maintain separate log book for documenting various activities of the project.					

Suggestive outline for the complete project report is as follows.

Abstract

Chapter 1. Introduction

- Background
- Motivation
- Problem Definition
- Scope
- Objective
- Organization of Report
- Summary

Chapter 2. Literature Review

Chapter 3. Design & development / Experimentation & observation / Survey & Data collection

Chapter 4. Testing, Analysis & Validation / Results & discussions / Data interpretation

Chapter 5. Conclusion & Future Work

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				Assessment by Departmental Committee			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.