



**POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI**  
**Choice Based Credit System (CBCS)**  
**Scheme of Teaching and Examination 2018 – 19**  
**(Effective from the academic year 2018 – 19)**

**VII Semester**

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Week					Examination			Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1.	PC	18AU71	Automotive Pollution and Control	Automobile Engineering	3	-	--	--	03	50	50	100	3
2.	PC	18AU72	Control Engineering	Automobile Engineering	3	2	--	---	03	50	50	100	4
3.	PE	18AU73X	Elective- 3	Automobile Engineering	3	2	--	--	03	50	50	100	4
4.	PE	18AU74X	Elective-4	Automobile Engineering	3	--	--	--	03	50	50	100	3
5.	OE	18AU7OE	Open Elective- II	Automobile Engineering	3	--	--	--	03	50	50	100	3
6.	PC	18AUL76	Automobile Engineering Lab - III	Automobile Engineering	--	--	2	--	03	50	50	100	1
7.	PC	18AU77	Seminar/Case study/Group work/Virtual Lab	Automobile Engineering	--	--	2	--	03	50	50	100	1
8.	PROJ	18AUP77	Project Work Phase - I	Automobile Engineering	--	--	4	--	03	50	50	100	2
9.	INT	18AUI78	Internship	(To be carried out during the intervening vacations of VI and VII semesters )					-	--	--	--	-
<b>Total</b>					<b>15</b>	<b>04</b>	<b>08</b>	<b>00</b>	<b>27</b>	<b>400</b>	<b>400</b>	<b>800</b>	<b>21</b>
<b>Note: PC: Professional core, PE: Professional Elective, OE: Open Elective, MP: Mini-project, INT: Internship.</b>													
<b>Internship:</b> All the students admitted to III year of BE/B.Tech have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters.													

**Elective - 3: 18AU731:** Mechanical Vibration and Vehicle Dynamics, **18AU732:** Finite Element Method, **18AU733:** Composite Materials.

**Elective - 4: 18AU741:** TM&E, **18AU742:** Nano Technology, **18AU743:** Smart Material.

**Open Elective- II: 18AU7OE:** Hybrid and Electric vehicles

**POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI**  
**Choice Based Credit System (CBCS)**  
**Scheme of Teaching and Examination 2018 – 19**  
**(Effective from the academic year 2018 – 19)**

**VIII Semester**

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Week			Examination			Credits	
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	SEE Marks	CIE Marks		Total Marks
1.	PC	18AU81	Vehicle body engg and earth moving equipments	Automobile Engineering	3	--	--	03	50	50	100	3
2.	PE	18AU82X	Elective- 5	Automobile Engineering	3	--	--	03	50	50	100	3
3.	OE	18AU8OE	Open Elective- III	Automobile Engineering	3	--	--	03	50	50	100	3
4.	MOOC S	18AUMC84	Certification Course(NPTEL/MOOC S)	--	--	--	--	--	--	--	--	1
5.	PROJ	18AUP85	Project Work Phase – II	Automobile Engineering	--	--	20	03	50	50	100	10
6.	INT	18AUI86	Internship	(Completed during the intervening vacations of VI and VII semesters and /or VII and VIII semesters.)			--	--	--	--	--	2
<b>Total</b>					<b>9</b>	<b>--</b>	<b>20</b>	<b>29</b>	<b>200</b>	<b>200</b>	<b>400</b>	<b>22</b>

**Note: PC: Professional core, PE: Professional Elective, OE: Open Elective, MP: Mini-project, INT: Internship.**

**Internship:** All the students admitted to III year of BE/B.Tech have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters.

**Elective – 5: 18AU821:** Vehicle maintenance **18AU822:** Total Quality Management, **18AU822:** Energy Conservation and Auditing.

**Open Elective – III: 18AU8OE:** Non Conventional Energy Sources.

<b>AUTOMOTIVE POLLUTION AND CONTROL</b>		
Course Code	<b>18AU71</b>	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
<b>Modules</b>		<b>Teaching Hours</b>
<p align="center"><b>Module -1</b></p> <p><b>INTRODUCTION:</b> Pollutants - sources - formation - effects – transient operational effects on pollution.  <b>INFLUENCE OF FUEL PROPERTIES:</b> Effect of petrol, Diesel Fuel, Alternative Fuels and lubricants on emissions.</p>		7 hours
<p align="center"><b>Module -II</b></p> <p><b>SI ENGINE COMBUSTION AND POLLUTANT FORMATION:</b>  Chemistry of SI engine combustion - HC and CO formation in 4-stroke and 2-stroke SI engines - NO formation in SI engines - Particulate emissions from SI engines - Effects of operating variables on emission formation.</p>		9 hours
<p align="center"><b>Module -III</b></p> <p><b>CI ENGINE COMBUSTION AND EMISSIONS:</b> Basics of diesel combustion, diesel spray, Smoke emission in diesel engines - NO emission from diesel engines– Particulate emission in diesel engines. Effects of operating variables on emission formation. Diesel trap oxidizers.</p>		9 hours
<p align="center"><b>Module -IV</b></p> <p><b>CONTROL TECHNIQUES FOR SI AND CI ENGINE EMISSION REDUCTION:</b> Design changes - Optimization of operating factors– NO emission control techniques, Fumigation - Air injection PCVsystem - Exhaust treatment in SI engines - Thermal reactors - Catalytic converters - Catalysts - Use of unleaded petrol.</p>		9 hours
<p align="center"><b>Module -V</b></p> <p><b>MEASUREMENT &amp; INSTRUMENTATION FOR EMISSION:</b> Test procedures - NDIR analyzer - Flame ionization detectors – Chemiluminescent analyzer – Gas chromatograph – Smoke</p>		8 hours

meters - Emission - standards. Measurement evaporative emissions		
<b>Laws and Regulation</b> – Regulatory test procedures – American driving cycles, European cycles, Japanese cycles.		
<b>Question paper pattern:</b>		
1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.		
2. Five full questions are to be answered selecting at least One full question from each Module.		
3. Each question should not have more than 3 sub divisions		
<b>Text books: Text Books:</b>		
1. Engine Emission -Springer and Patterson, Plenum Press, 1990.		
2. Automobiles and Pollution - Paul Degobert (SAE)		
3. Internal combustion engine fundamentals – John B. Heywood, McGraw-Hill, 1998		
<b>Reference Books:</b>		
1. Ganesan.V., “Internal Combustion Engines “, Tata McGraw Hill Co., 1994.		
2. SAE Transactions, “Vehicle emission “, 1982 (3 volumes).		
3. Obert.E.F., “Internal Combustion Engines “, 1982.		
4. Taylor.C.F., “Internal Combustion Engines “, MIT Press, 1972.		
<b>E books and online course materials:</b>		
<a href="https://www.ncbi.nlm.nih.gov/books/NBK218144/">https://www.ncbi.nlm.nih.gov/books/NBK218144/</a>		
<a href="https://www.tandfonline.com/doi/pdf/10.1080/00022470.1963.10468138">https://www.tandfonline.com/doi/pdf/10.1080/00022470.1963.10468138</a>		
<a href="https://www.tandfonline.com/doi/pdf/10.1080/00966665.1958.10467845">https://www.tandfonline.com/doi/pdf/10.1080/00966665.1958.10467845</a>		
<a href="https://www.diva-portal.org/smash/get/diva2:1155571/FULLTEXT02.pdf">https://www.diva-portal.org/smash/get/diva2:1155571/FULLTEXT02.pdf</a>		
<a href="https://www.technicalsymposium.com/alllecturenotes_auto.html">https://www.technicalsymposium.com/alllecturenotes_auto.html</a>		
<b>Course outcomes:</b>		
<b>On completion of the course, the student will have the ability to:</b>		
.		
<b>Course Code</b>	<b>CO #</b>	<b>Course Outcome (CO)</b>
<b>18AU71</b>	<b>CO1</b>	Explain pollutants emitted by engines and their effects on environment and human health.
	<b>CO2</b>	Emission formation in SI and CI Engines.

	<b>C03</b>	Effect fuel properties on emission and use of alternate fuels.
	<b>C04</b>	Concepts of control techniques in emission in IC Engines .
	<b>C05</b>	Explain principles of working of pollution measuring instruments.

Course Title:CONTROL ENGINEERING		
Course Code	18AU72	CIE: 50
Number of Lecture Hours/Week	3 hrs. (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
Modules		TeachingHours
<p align="center"><b>MODULE - I</b></p> <p><b>INTRODUCTION:</b> Concept of automatic controls, open and closedloop systems, concepts of feedback, requirement of an ideal controlsystem.</p> <p><b>MATHEMATICAL MODELS:</b> Transfer function models, models ofmechanical systems, models of electrical circuits, DC and AC motorsin control systems, models of thermal systems, models of hydraulicsystems. Pneumatic system.</p>		09 Hours
<p align="center"><b>MODULE - II</b></p> <p><b>BLOCK DIAGRAMS:</b> TransferFunctions definition, function, blocks representation of systemelements, reduction of block diagrams.</p> <p><b>SIGNAL FLOW GRAPHS:</b> Construction and system representation using signal flow graphs. Mason'sgain formula for reduction for reduction of signal flow graphs.</p>		08 Hours
<p align="center"><b>MODULE - III</b></p> <p><b>TRANSIENT AND STEADY STATE RESPONSE ANALYSIS:</b> Introduction, first order and second order systems response to step,ramp and impulse inputs, concepts of time constant and itsimportance in speed of response.</p> <p><b>SYSTEM STABILITY:</b> Routh's-Hurwitz Concept of stability, Hurwitz stability criterion, Routh's stability criterion.</p>		08 Hours
<p align="center"><b>MODULE - IV</b></p>		

<p><b>FREQUENCY RESPONSE ANALYSIS:</b> Polar plots, Nyquist Stability criterion, Stability Analysis, Relative stability concepts, phase and gain margin, M &amp; N circles.</p> <p><b>FREQUENCY RESPONSE ANALYSIS USING BODE PLOTS:</b> Bode attenuation diagrams, Stability Analysis using Bode plots, Simplified Bode Diagrams.</p>	<p>08 Hours</p>	
<p><b>MODULE - V</b></p> <p><b>ROOT LOCUS PLOTS:</b> Definition of root loci, general rules for constructing root loci, Analysis using root locus plots.</p> <p><b>SYSTEM COMPENSATION:</b> Series and feedback Compensation, Proportional, Integral, Proportional Integral, Proportional Integral Differential controllers.</p>	<p>09 Hours</p>	
<p><b>Question paper pattern:</b></p> <ol style="list-style-type: none"> <li>1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.</li> <li>2. Five full questions are to be answered selecting at least One full question from each Module.</li> <li>3. Each question should not have more than 3 sub divisions</li> </ol>		
<p><b>Text books:</b> 1. Modern Control Engineering - Katsuhiko Ogata, Pearson Education, 2004. 2. Control Systems - I.J. Nagarath &amp; M. Gopal, New age International publishers 2002</p>		
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Feedback Control Systems – Joseph.J. Distefano, Schaum’s series 2001.</li> <li>2. Control Systems - Principles and Design - M. Gopal, TMH, 2000</li> <li>3. Automatic Control Systems – B.C. Kuo, F. Golnaraghi, John Wiley &amp; Sons, 2003.</li> <li>4. Automatic Control Systems – Francis.H. Raven, Mc Graw Hill Publications, England</li> <li>5. Control systems – W. Bolton, Elsevier Ltd.</li> <li>6. Modern control system - Peter Dransfield</li> </ol>		
<p><b>E books and online course materials:</b></p>		
<p><b>Course outcomes:</b> <b>On completion of the course, the student will have the ability to:</b></p>		
<p><b>Course Code</b></p>	<p><b>CO #</b></p>	<p><b>Course Outcome (CO)</b></p>



<b>18AU72</b>	<b>C01</b>	Interpret the concept of control systems and their mathematical models and obtain transfer function
	<b>C02</b>	Evaluate transfer functions using block diagram, signal flow graphs
	<b>C03</b>	Analyze the time response of the systems and predict stability using algebraic criteria.
	<b>C04</b>	Obtain frequency response using Nyquist criteria and Bode diagrams and comment on stability of the systems.
	<b>C05</b>	Construct root locus and analyze the systems and explain controllers actions and compensation

Course Title: <b>Mechanical Vibration and Vehicle Dynamics</b>		
Course Code	<b>18AU731</b>	CIE: 50
Number of Lecture Hours/Week	<b>3 hrs. (Theory)</b>	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
<b>Modules-1</b>		<b>Teaching Hours</b>
<p>1. UNDAMPED FREE VIBRATION: Introduction, energy method, Newton's method and D'Alembert's principle single degree of freedom system, natural frequency, Rayleigh's method, stiffness of spring elements, effects of spring mass. .</p> <p>DAMPED FREE VIBRATION: Single degree of freedom systems, different types of damping, concept of critical damping and its importance, response study of viscous damped systems for cases of under damping and over damping, logarithmic decrement.</p>		<b>09 Hours</b>
<b>Modules-2</b>		
<p>2. FORCED VIBRATION: Single degree of freedom systems, steady state solution with viscous damping due to harmonic force solution by complex algebra, concept of response, reciprocating an rotating unbalance, vibration isolation- transmissibility ratio, energy dissipated by damping, equivalent viscous damping, structural damping, sharpness of resonance and base excitation.</p> <p>.</p>		<b>08 Hours</b>
<b>Modules-3</b>		
<p>3. Vibration measuring instruments.</p> <p>SYSTEMS WITH TWO DEGREE OF FREEDOM: Introduction, principle modes and normal modes. Co-ordinate coupling, generalized and principle co-ordinate, free vibrations in terms of initial conditions, Lagrange's equation, semi-definite systems, forced oscillations, harmonic excitation.</p>		<b>08 Hours</b>

<b>Modules-4</b>		
4. VEHICLE VIBRATION AND HUMAN COMFORT: vehicle vibration with single degree of freedom of free vibration, forced vibration, vibration due to road roughness, vibration due to engine unbalance, transmissibility of engine mounting, compensated suspension systems forced vibration. Human comfort criteria.		<b>08 Hours</b>
<b>Modules-5</b>		
METHODS FOR MULTIDEGREE OF FREEDOM SYSTEMS: Introduction, influence coefficients, Maxwell's reciprocal theorem, Determination of natural frequencies using Dunkerley's equation, matrix iteration, Holzer's method, Stodola method		<b>09 Hours</b>
<b>Question paper pattern:</b>		
Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.		
2. Five full questions are to be answered selecting at least One full question from Each Module.		
3. Each question should not have more than 4 sub divisions		
<b>Text books:</b> 1. Mechanical Vibration – G.K. Grover, Nemchand & Brothers, 1989		
2. Vibration Theory & Application – William I Thomson, Prentice Hall		
3. Mechanical Vibration – V.P. Singh, Dhanpat Rai & company pvt. Ltd.		
<b>Reference Books:</b>		
1. Mechanical Vibration – Church, Wiley international.		
2. Mechanics of Pneumatic Tyre – S.K. Clark, Prentice Hall		
3. Theory & problems of Mechanical Vibration – William W. Seto, McGrawHill		
4. Vibration Theory Mechanical Vibrations – S.S.Rao, Pearson Edu. Inc.		
5. Mechanical Vibration Analysis – P. Srinivasan, TMH		
6. Vibration and Noise for engineers-Kewal pujara & R.S.Pujara, Dhanpat Rai.		
<b>E books and online course materials:</b>		
<b>Course outcomes:</b>		
<b>On completion of the course, the student will have the ability to:</b>		
<b>Course Code</b>	<b>CO #</b>	<b>Course Outcome (CO)</b>
<b>18AU731</b>	<b>CO1</b>	Classify different types of vibration, Calculate natural frequency and other parameters of single Degree of

		freedom.
	<b>C02</b>	Calculate natural frequency, logarithmic decrement & other parameters of single degree of freedom of Damped vibrating systems.
	<b>C03</b>	Compute the response of Harmonic Excitation forces acting on One and Two degree of freedom.
	<b>C04</b>	Analyze the human comfort due to road roughness, engine unbalance, compensated suspension systems.
	<b>C05</b>	Analyze the concept of Multi-degree of freedom of mechanical vibrating system

<b>Course Title: TRANSPORT MANAGEMENT AND ECONOMICS (ELECTIVE)</b>		
Course Code	<b>18AU741</b>	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
<b>Modules</b>		<b>Teaching Hours</b>
<p align="center"><b>MODULE – I</b></p> <p><b>ADMINISTRATIVE ORGANIZATION:</b> Principal function of administrative, traffic, secretarial and engineering divisions, chain of responsibility, forms of ownership, Drivers and conductors duties, training and recruitment of drivers and conductors, factors affecting punctuality of service.</p> <p><b>ROUTE PLANNING:</b> Sources of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule, test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating traffic volume, estimated number of passengers, estimated traffic possibilities, single verses double deckers.</p>		09 Hours
<p align="center"><b>MODULE – II</b></p> <p><b>TIMING, BUS WORKING AND SCHEDULES:</b> Time table layout, uses of flat graph method of presentation, Preparation of vehicle and crew schedules, preparation of duty roster, co-operation with employers, use of vehicle running numbers, determination of vehicle efficiency, checking efficiency of crew duty arrangements.</p> <p><b>GARAGES AND BUS STATIONS:</b> Bus garages, requirements, layout of premises, size, function, location, design, equipment, use of machinery, garage organization, large scale overhaul system, requirement of facilities at depot legal provisions for depot, layouts. Bus stations: drive through type, head on type, facilities for passengers.</p>		08 Hours
<p align="center"><b>MODULE - III</b></p> <p><b>FARE COLLECTION SYSTEMS:</b> Need, Principles of fare collection the way bill, different types of fare collection systems, pre-printed denomination ticket, scribe/ hand written ticket, card ticket, advance booking/reservation, machine ticket, box system, personal and common stock</p> <p><b>THE FARES STRUCTURE:</b> Basis of fares, historical background,</p>		08 Hours

<p>stage, designing of stage, straight and tapered scale, flat fare, zonal fare, concession fares, charges for workmen, attracting traffic, compilation of fare table, anomalies, double booking, inter-availability, through booking and summation, private hire charges.</p>	
<p style="text-align: center;"><b>MODULE - IV</b></p> <p><b>PUBLIC RELATIONS WORK AND PREVENTION OF ACCIDENTS:</b> Dissemination of information, maintaining goodwill, handling complaints, traffic advisory committees, local contact, cooperation with press, news and articles, facilities for visitors, forms of publicity, importance of quality, inter departmental liaison, advertisements, signs, notices and directions, general appearance of premises, specialized publicity. <b>Prevention of Accidents:</b> Emphasis of safe driving, annual awards, bonus encouragement, vehicle design, platform layout, location of stops, scheduled speed, route hazards, records, elimination of accident prone drivers.</p> <p><b>MOTOR VEHICLE ACT:</b> Schedules and sections –Traffic signs and signals, Registration of motor vehicles - Licensing of drivers – Control of permits - Limits of speed - Constructional regulations.</p>	<p>08 Hours</p>
<p style="text-align: center;"><b>MODULE - V</b></p> <p><b>INTEREST AND DEPRECIATION:</b> Introduction, theory of interest, interest rate, interest from lender’s and borrower’s view point, simple and compound interest. Nominal and effective interest rates, interest formulae, Annual compounding, Annual payments and continuous compounding annual payment, simple numerical problems. Need for depreciation causes of depreciation life and salvage value methods of depreciation.</p> <p><b>COSTS:</b> Standard costs estimated cost, first cost, fixed cost, Variable costs, Incremental cost, Differential cost, Sunk and marginal cost, Breakeven and minimum cost analysis, simple numerical problems.</p>	<p>09 Hours</p>
<p><b>Question paper pattern:</b></p> <ol style="list-style-type: none"> <li>1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.</li> <li>2. Five full questions are to be answered selecting at least One full question from Each Module.</li> <li>3. Each question should not have more than 4 sub divisions</li> </ol>	
<p><b>Text books:</b></p> <ol style="list-style-type: none"> <li>1. Kitchin.L.D., Bus Operation - Iliffe and Sons Ltd., London, III edition</li> <li>2. Bus and coach operation, Rex W.Faulks, Butterworth version of 1987, London</li> <li>3. M.V.ACT 1988, Govt Publication.</li> <li>4. Engineering Economy - TARACHAND, Nem Chand and Brothers, Roorkee</li> <li>5. Mechanical Estimating and Costing, T. R. Banga and S. C. Sharma, Khanna Publishers, Delhi</li> </ol>	

6. Panneerselvam, R. *Engineering economics*. PHI Learning Pvt. Ltd., 2013.

**Reference Books:**

1. John Duke, Fleet Management - McGraw-Hill Co, USA -1984.
2. Industrial Engineering and Management - O.P KHANNA, Dhanpat Rai & Sons.
3. Engineering Economy, Thuesen, G. J. and Fabrycky, W . J., Prentice Hall of India Pvt. Ltd.

**E books and online course materials:**

<https://www.indiacode.nic.in/bitstream/123456789/9460/1/a1988-59.pdf>

[https://www.academia.edu/35775332/Engineering\\_Economics\\_by\\_Panneer\\_Selvam\\_pdf](https://www.academia.edu/35775332/Engineering_Economics_by_Panneer_Selvam_pdf)

**Course outcomes:**

**On completion of the course, the student will have the ability to:**

Course Code	CO #	Course Outcome (CO)
18AU741	<b>CO1</b>	Describe the administrative organization of road transport undertaking and role & responsibilities of different sections
	<b>CO2</b>	Identify and make planning of new route, prepare vehicles and crew schedule.
	<b>CO3</b>	Explain and select the different fare fixation and fare collection methods
	<b>CO4</b>	Describe infra structure facilities to be provided in a road transport undertaking
	<b>CO5</b>	Analyze causes of accidents and methods to prevent accidents; analysis interest and depreciation, cost and explain the MV act

Course Title: <b>Hybrid &amp; Electric Vehicles</b>		
Course Code	18AU70E	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
<b>Modules</b>		<b>Teaching Hours</b>
<b>Module-I</b> Electric Vehicles: Architecture of an electric vehicle, essentials and performance of electric vehicles –Traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations.		<b>09 Hours</b>
<b>Module-II</b> Hybrid Vehicles: Hybrid electric drivetrains -Concepts, architecture, design, control strategies, merits and demerits.		<b>09 Hours</b>
<b>Module-III</b> Electric Propulsion Systems: DC motor drives, induction motor drives, permanent magnet motor drives and switched reluctance motor drives.		<b>08 Hours</b>
<b>Module-IV</b> Energy Storage Devices: Electrochemical batteries –Reactions, thermodynamic voltage, lead-acid batteries, nickel based batteries, lithium based batteries, flywheel and ultra-capacitors, Battery management systems, range calculation.		<b>08 Hours</b>
<b>Module-V</b> Fuel Cell and Solar Powered Vehicles: Fuel cell thermodynamics, operating principle, fuel cell technologies, fuel reforming, hydrogen production and storage, open circuit voltage flow rate testing and evaluation. Photovoltaic cell, maximum power point tracking, solar powered accessories, hybrid solar vehicles. Fuel Cell testing and evaluation.		<b>08 Hours</b>
<b>Course outcomes:</b> After studying this course, students will be able to: CO1: Explain need of renewable energy sources; analyze solar geometry and solar energy and its measurement. CO2: Describe about principle of operation of solar energy systems and storage. CO3: Estimate power in wind energy and describe wind energy conversion systems.		



CO4: Explain biomass energy, production of biogas and biomass gasification.

CO5: Explain emerging technologies such as hydrogen energy, fuel cell, small hydro power and ocean energy.

**Question paper pattern:** Two questions from each module to be set and students have to answer one question from each module

**Text books:**

1. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2009.
2. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2011.

**Reference Books:**

1. Seref Soylu "Electric Vehicles -The Benefits and Barriers", InTech Publishers, Croatia, 2011.
2. Aulice Scibioh M. and Viswanathan B., "Fuel Cells –Principles and Applications", University Press, India, 2006.
3. Barbir F., "PEM Fuel Cells: Theory and Practice" Elsevier, Burlington, 2005.
4. James Larminie and John Lounry, "Electric Vehicle Technology-Explained", John Wiley & Sons Ltd., 2003.

**E books and online course materials:**

1. <http://ceb.ac.in/knowledge-center/E-BOOKS/Modern%20Electric%2C%20Hybrid%20Electric%20%26%20Fuel%20Cell%20Vehicles%20-%20Mehrdad%20Ehsani.pdf>
2. <https://nptel.ac.in/courses/108/102/108102121/>
3. <https://nptel.ac.in/courses/108/106/108106170/>

**Course outcomes:**

**On completion of the course, the student will have the ability to:**

Course Code	CO #	Course Outcome (CO)
18AU70E	CO1	Analyse the challenges of electric vehicle over conventional IC engine powered vehicles.
	CO2	Apply the degree of hybridization and alternate power train architectures for a conventional system.
	CO3	Evaluate the characteristics and maximum power demand of electric and hybrid drive propulsion system.
	CO4	Analyse the performance and characteristics of battery and electronics converters for the vehicle propulsion systems.
	CO5	Analyse the performance and characteristics of fuel cell for the vehicle Propulsion system.

<b>Course Title: Automobile Engineering –Lab III</b>		
Course Code	18AUL76	CIE: 50
Number of Hours/Week	2 (Practical)	SEE: 50
Total Number of Hours	28	SEE Hours: 03
<b>Modules</b>		<b>Teaching Hours</b>
<ol style="list-style-type: none"> <li>1. Study and practice on cylinder reboring machine.</li> <li>2. Study and practice on valve refacing machine.</li> <li>3. Study of re-treading and vulcanizing.</li> <li>4. Study and practice on Brake Drum Skimming Lathe.</li> <li>5. Study and practice on wheel balancing machine and wheel alignment machine.</li> <li>6. Exhaust emission test of petrol and diesel engine.</li> <li>7. Head light focusing test</li> <li>8. Road worthiness tests</li> <li>9. Braking distance test</li> <li>10. Drawing of Automobile bodies</li> </ol>		28 hours
<b>Text books:</b>		
<b>Reference Books:</b>		

**Course outcomes:**

**On completion of the course, the student will have the ability to:**

<b>Course Code</b>	<b>CO #</b>	<b>Course Outcome (CO)</b>
<b>18AU76</b>	<b>CO1</b>	Analyze, measure and re-condition cylinder bore and valve.
	<b>CO2</b>	Demonstrate skimming of brake drum for pitting and wear and understand the process of re-treading and vulcanizing
	<b>CO3</b>	Apply the knowledge of Automobile theory to study about wheel balancing machine, Wheel alignment machine and measure exhaust emission
	<b>CO4</b>	Carry out head light focusing and visibility test and Road worthiness test for Vehicle,
	<b>CO5</b>	To carry out braking distance test. Draw and describe about different automotive bodies.

<b>VEHICLE BODY ENGINEERING AND EARTH MOVING EQUIPMENTS</b>		
Course Code	<b>18AU81</b>	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
<b>Modules</b>		<b>Teaching Hours</b>
<b>MODULE - I</b> <b>VEHICLE BODY DETAILS AND MATERIALS:</b> Types: Saloon, Convertibles, Limousine, Estate Van, Racing and Sports car. Bus Types: Mini bus, single decker, double decker, two level, split level and articulated bus - Bus body layout, Floor height, Engine location, Entrance and exit location, seating dimensions, constructional details		8 Hours
<b>MODULE - II</b> <b>VEHICLE VISIBILITY AND SAFETY:</b> Visibility: regulations, driver's visibility, tests for visibility - Methods of improving visibility and space in cars, Safety: safety design. Safety equipments for cars. Car body construction. Dimensions of driver's seat relation to controls Drivers cab design		8 Hours
<b>MODULE - III</b> <b>VEHICLE AERODYNAMICS :</b> Objectives - Vehicle drag and types - various types of forces and moments - Effects of forces and moments Side wind effects on forces and moments Various body optimization techniques for minimum drag – Wind tunnel testing: Flow visualization techniques, Scale model testing,		9 Hours
<b>MODULE - IV</b> <b>EARTH MOVING MACHINES:</b> Bulldozers, cable and hydraulic dozers. Crawler track, Loaders, single bucket, multi bucket and rotary types. <b>SCRAPERS AND GRADERS:</b> Scrapers, elevating graders, self powered scrapers and graders. <b>SHOVELS:</b> Power shovel, revolving and stripper shovels -		9 Hours

<p>draglines - ditchers Capacity of shovels.</p> <p><b>HYDRAULICS:</b> Basic components of hydraulic systems like pumps, control valves, relief valves and hydraulic motors and hydraulic cylinders.</p>	
<p style="text-align: center;"><b>MODULE - V</b></p> <p><b>HAULING EQUIPMENTS:</b>  <b>TRACTORS AND DUMPERS:</b> Classification of tractors, safety rules, working attachment of tractors, farm equipment classification auxiliary equipments – trailers and body.</p> <p><b>DUMPERS:</b> capacity, operation, preventive Maintenance, production estimates, equipment trailers.</p>	<p>8 Hours</p>
<p><b>Question paper pattern:</b></p> <ol style="list-style-type: none"> <li>1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.</li> <li>2. Five full questions are to be answered selecting at least One full question from each Module.</li> <li>3. Each question should not have more than 4 sub divisions</li> </ol>	
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Giles.J.C. “ Body construction and design “, Iliffe Books Butterworth &amp; Co., 1971</li> <li>2. John Fenton, “ Vehicle Body layout and analysis “, Mechanical Engg Publication Ltd., London, 1982.</li> <li>3. Braithwaite.J.B., “ Vehicle Body building and drawing “, Heinemann Educational Books Ltd., London, 1977.</li> <li>4. Sydney.F.Page</li> <li>5. 1. Abrosimov. K. Bran berg.A. and Katayer.K., “ Road making Machinery “, MIR Publishers, Moscow, 1971.</li> <li>6. Wang.J.T., “ Theory of Grand vehicles “, John Wiley &amp; Sons, New York, 1987.</li> <li>7. Off the road wheeled and combined traction devices - Ashgate Publishing Co. Ltd. 1998.</li> <li>8. Tractors and their power units by John B LIizedaw et-al</li> </ol>	
<p><b>E books and online course materials:</b></p> <p><a href="https://www.slideshare.net/rafiyaparveen1994/earth-moving-equipments-55235550">https://www.slideshare.net/rafiyaparveen1994/earth-moving-equipments-55235550</a></p> <p><a href="http://www.earthmovers-magazine.com.au/">www.earthmovers-magazine.com.au/</a></p> <p><a href="https://www.nbmcw.com/...material.../35838-sany-material-handling-earth-moving-eq..">https://www.nbmcw.com/...material.../35838-sany-material-handling-earth-moving-eq..</a></p>	

[www.visualdictionaryonline.com/transport-machinery/heavy-machinery.php](http://www.visualdictionaryonline.com/transport-machinery/heavy-machinery.php)

**Course outcomes:**  
**On completion of the course, the student will have the ability to:**

<b>Course Code</b>	<b>CO #</b>	<b>Course Outcome (CO)</b>
<b>15AU73</b>	<b>CO1</b>	Enumerate concepts of Vehicle body construction and materials used.
	<b>CO2</b>	Expose students to international safety and visibility standards in cars.
	<b>CO3</b>	Illustrate the concepts of vehicle aerodynamics in passenger cars..
	<b>CO4</b>	Distinguish different earth moving equipments and their operations.
	<b>CO5</b>	Identify heavy earth hauling vehicles and their operational characteristics.

Course Title: <b>VEHICLE MAINTENANCE</b>		
Course Code	<b>18AU821</b>	CIE: 50
Number of Lecture Hours/Week	<b>3 hrs. (Theory)</b>	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
<b>Modules-1</b>		<b>Teaching Hours</b>
<b>MODULE - I</b> <b>MAINTENANCE RECORDS AND SCHEDULE</b> : Importance of maintenance. Types of maintenance. Preparation of check lists. Chassis lubrication cost effectiveness pre-trip. inspection forms, log books, trip sheets, other maintenance record forms. special tools used for maintenance, repair and overhauling.		08 Hours
<b>MODULE - II</b> <b>MAINTENANCE, REPAIR AND OVERHAULING OF ENGINE:</b> Dismantling of engine components. cleaning methods .visual inspection and dimensional check of various engine components. Minor and major tune up reconditioning, repairing methods of engine components.		09 Hours
<b>MODULE - III</b> <b>MAINTENANCE, REPAIR AND OVERHAULING OF CHASSIS DRIVE LINE COMPONENTS:</b> Clutch-mechanical, automatic types gear box-mechanical automatic types. final reduction. propeller shaft. front and rear suspension systems. rigid and independent types. Brakes systems-hydraulic, servo, Air bleeding. Steering system. Wheel alignment-tyres.		08 Hours
<b>MODULE - IV</b> <b>MAINTENANCE ,REPAIR AND SERVICING OF ELECTRICAL SYSTEMS.</b> Battery-testing methods. starter motor. Charging system DC generator, AC Alternator, Regulator, Ignition systems-coil ignition, Transistor assisted ignition, capacitor discharge ignition electric horn, wiper, flasher, electric fuel pump, gauges. Lighting system headlight focusing. Wiring system		08 Hours
<b>MODULE - V</b> <b>MAINTENANCE, REPAIR AND SERVICING OF COOLING SYSTEM</b> Cooling system-types, Water pump, radiator, thermostat valve. Anti corrosion and anti freezing solution.		09 Hours

<p><b>LUBRICANT ION SYSTEMS, FUEL SYSTEM AND BODY :</b>  Lubricating system-oil analysis, oil topping up, oil change, oil filters, oil relief value. Fuel system-petrol, diesel fuel feed system components.  Body repair tools, minor body panel beating, tinkering, soldering, polishing, painting. Door locks mechanism. Window glass actuating mechanism.</p>		
<p><b>Question paper pattern:</b>  1. Total of Ten Questions with Two questions from each Module to be set covering the entire syllabus.  2. Five full questions are to be answered selecting at least One full question from Each Module.  3. Each question should not have more than 3 sub divisions</p>		
<p><b>Text books:</b> 1. JOHN Doke, "fleet management", Mc Graw Hill Co 1984  2. Judge. A.N., "motor vehicle engine servicing, 3rd Edition", Pitman paper pack, London, 69.  3. Judge. A.W., "maintenance of high speed diesel engine", chapman hall ltd., 56.  4. Maleev. V.L. "Diesel engine operation and maintenance " maintenance, McGraw Hill book Co., New York, 1954</p>		
<p><b>Reference Books:</b>  1. John W.Vale.J.R., "Modern auto body and finder repair".  2. Venk. Spicer. "Automotive maintenance and troubleshooting".  3. "Vehicle service manuals of reputed manufactures".</p>		
<p><b>E books and online course materials:</b></p>		
<p><b>Course outcomes:</b>  <b>On completion of the course, the student will have the ability to:</b></p>		
Course Code	CO #	Course Outcome (CO)
18AU821	CO1	Explain the basic technologies as related to vehicle maintenance and maintenance strategies.
	CO2	Identify the failure of engine components and recondition.
	CO3	Explain the concepts of repair and overhaul of chassis drive line components
	CO4	Discuss the methods of battery testing and servicing of electrical systems
	CO5	Analyze the failure and servicing of cooling, lubrication, fuel system and body repair.



Course Title: <b>Non-conventional Energy Sources</b>		
Course Code	18AU8OE	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
<b>Modules</b>		<b>Teaching Hours</b>
<p align="center"><b>Module-I</b></p> <p><b>INTRODUCTION TO ENERGY SOURCES:</b> Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources.</p> <p><b>SOLAR ENERGY :</b> Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length, <b>Solar thermal systems:</b> flat plate collectors, concentrating collectors, advantages and disadvantages of concentrating collectors over flat plate type collectors</p>		<b>09 Hours</b>
<p align="center"><b>Module-II</b></p> <p><b>STORAGE OF SOLAR ENERGY:</b> Thermal storage, solar pond, solar water heaters, solar distillation.</p> <p><b>SOLAR PHOTO-VOLTAIC:</b> Solar Cell Principle, Semiconductor Junctions, Conversion efficiency and power output, Basic Photo Voltaic System for Power Generation.</p> <p><b>WIND ENERGY :</b> Principle of wind energy conversion – nature of the wind, the power in the wind, forces on the blades, wind energy conversion; wind data and energy estimation, Site selection considerations , basic components of wind energy conversion systems (WECS); classification of WECS, advantages and disadvantages of WECS.</p>		<b>09 Hours</b>
<p align="center"><b>Module-III</b></p>		<b>08 Hours</b>

<p><b>BIOMASS</b> : Biomass conversion technologies, photosynthesis, Biogas generation plants, Factors affecting bio-digestion, classification, advantages and disadvantages of floating drum plant and fixed dome plant, problems related to bio gas plants, fuel properties and utilization of bio-gas, biomass as a source of energy, thermal gasification of biomass.</p>	
<p style="text-align: center;"><b>Module-IV</b></p> <p><b>HYDROGEN ENERGY AND FUEL CELL:</b> Introduction, Hydrogen production, electrolysis, thermo-chemical methods; hydrogen storage, transportation, utilization. Fuel cells: Overview; Classification of fuel cells; operating principles; Fuel cell thermodynamics.</p>	<p><b>08 Hours</b></p>
<p><b>Module-V</b></p> <p><b>SMALL HYDRO POWER:</b> Classification as micro, mini and small hydro projects - Basic concepts and types of turbines - Design and selection considerations. <b>OCEAN ENERGY:</b> Tidal Energy -Principle of working, performance and limitations. Wave Energy Principle of working, performance and limitations. Ocean Thermal Energy - Availability, theory and working principle, performance and limitations.</p>	<p><b>08 Hours</b></p>
<p><b>Course outcomes:</b> After studying this course, students will be able to: CO1: Explain need of renewable energy sources; analyze solar geometry and solar energy and its measurement. CO2: Describe about principle of operation of solar energy systems and storage. CO3: Estimate power in wind energy and describe wind energy conversion systems. CO4: Explain biomass energy, production of biogas and biomass gasification. CO5: Explain emerging technologies such as hydrogen energy, fuel cell, small hydro power and ocean energy.</p>	
<p><b>Question paper pattern:</b> Two questions from each module to be set and students have to answer one question from each module</p>	
<p><b>Text books:</b> 1. G D Rai, Non- conventional sources of energy, Khanna Publishers, New Delhi, 2005 2. P S Sukhatme, Solar Energy, 2nd Edition, Tata McGraw Hill Publications</p>	
<p><b>Reference Books:</b> 1. Alternative Energy Sources - B.L. Singhal - Tech Max Publication 2. M.V.R. Koteswara Rao, “ Energy Resources: Conventional &amp; Non-Conventional “ BSP Publications,2006.</p>	

3. D.S. Chauhan, "Non-conventional Energy Resources" New Age International
4. Solar Engineering of Thermal Processes by Duffic and Beckman, John Wiley John
5. Twidel and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006

**E books and online course materials:**

4. <https://nptel.ac.in/courses/121106014/>
5. [https://onlinecourses.nptel.ac.in/noc18\\_ge09/preview](https://onlinecourses.nptel.ac.in/noc18_ge09/preview)
6. <https://gctbooks.files.wordpress.com/2016/02/renewable-energy-resources-by-john-twidell-tony-weir.pdf>

**Course outcomes:**

**On completion of the course, the student will have the ability to:**

Course Code	CO #	Course Outcome (CO)
<b>18AU8OE</b>	<b>CO1</b>	Explain need of renewable energy sources; analyze solar geometry and solar energy and its measurement.
	<b>CO2</b>	Describe about principle of operation of solar energy systems and storage.
	<b>CO3</b>	Estimate power in wind energy and describe wind energy conversion systems.
	<b>CO4</b>	Explain biomass energy, production of biogas and biomass gasification.
	<b>CO5</b>	Explain emerging technologies such as hydrogen energy, fuel cell, small hydro power and ocean energy.

Course Title: <b>Composite Materials</b>		
Course Code	18AU733	CIE: 50
Number of Lecture Hours/Week	4 (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
<b>Modules</b>		<b>Teaching Hours</b>
<b>Module-I</b> <b>Introduction to composite materials:</b> Definition, Classification, Types of matrices & reinforcements, characteristics & selection, Fiber composites, laminated composites, particulate composites, prepegs, sandwich construction. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. Advantages and application of composites		<b>09 Hours</b>
<b>Module-II</b> Organic fibers, ceramic fibers and metallic fibers-Their fabrication, structure, properties and application and comparison		<b>09 Hours</b>
<b>Module-III</b> Matrix materials: Polymers, metals and ceramic matrix materials. Interfaces – wettability and bonding, interface in composites interactions at the interface, types of bonding at the interface. Tests for measuring interfacial strength.		<b>08 Hours</b>
<b>Module-IV</b> Polymer matrix composites, metal matrix composites, ceramic metal composites		<b>08 Hours</b>
<b>Module-V</b> Carbon fiber composites and multifilament superconducting composites. Nano composites. Elementary treatment of micro and macro mechanics of composites. Strength, fracture, fatigue and design.		<b>08 Hours</b>
<b>Question paper pattern:</b> Two questions from each module to be set and students have to answer one question from each module		
<b>Text books:</b> <ol style="list-style-type: none"> <li>1. Composite materials (science &amp; Engineering – K.K Chawala</li> <li>2. Introduction to material science for Engineers – James F Shackelford, Macmillan. New York.</li> </ol>		

3. Material Science and Engineering – L.H.Van Vlack
4. Modern ceramic engineering- D W Richardson
5. Hand Book of Composite materials – American Chemical Society