KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
(Deemed to be University)
AnandNagar,Krishnankoil-626126
SrivilliputhurTaluk,VirudhunagarDistrict,TamilNadu,India

CURRICULUMANDSYLLABUS

(2018-2019)

M.TECH

(AUTOMOTIVE SYSTEMSENGINEERING)

Regulation 2018

Proposed Structure for M.Tech - Automotive System Engineering

Sl.No.	Course Type	Credits Proposed	Credits
1	Core Theory Course	15	15
2	Lab Courses	6-8	6
3	Supportive Course	4	4
4	Program Specific Electives	15	15
5	Inter Disciplinary/ General Electives	3	3
6	Mini Project	2	2
7	Project Work	26	26
8	Audit Courses	-	-
	Total	**71 - 73**	**71**

1. Core Theory Courses

Sl.No.	Course Code	Course Name	Course Type	L	T	P	C
1	AUT18R5001	Vehicle Engine Technology	T	3	0	0	3
2	AUT18R5002	AutomotiveMaterialsandMetallurgy	T	3	0	0	3
3	AUT18R5003	Manufacturing and Testing of Automotive Components	T	3	0	0	3
4	AUT18R5004	Automotive Chassis and Body Engineering	T	3	0	0	3
5	AUT18R5005	Automotive Transmission system	T	3	0	0	3
						Total	**15**

2. Lab Courses

Sl.No.	Course Code	Course Name	Course Type	L	T	P	C
1	AUT18R5081	Computer Aided Vehicle Design and Analysis Laboratory	L	0	0	3	2
2	AUT18R5082	Automotive and Autotronics Laboratory	L	0	0	3	2
4	AUT18R5083	Combustion and Emission Analysis laboratory	L	0	0	3	2
						Total	**6**

3. Supportive courses

Sl.No.	Course Code	Course Name	Course Type	L	T	P	C
1	MAT18R5002	Statistics and Computational Techniques	SC	3	0	0	3
2	PGM18R5001	Research Methodology	SC	1	0	0	1
						Total	**4**

4. Program Electives

Sl.No.	Course Code	Course Name	Pre-Requisite	Course Type	L	P	T	C
1	AUT18R5006	Supercharging and Scavenging	AUT18R5001	T	3	0	0	3
2	AUT18R5007	Alternative Fuels for IC Engines	AUT18R5001	T	3	0	0	3
3	AUT18R5008	Combustion and Emission in Engines	AUT18R5001	T	3	0	0	3
4	AUT18R5009	Engine Pollution and Control	AUT18R5001	T	3	0	0	3
5	AUT18R5010	Engine Auxiliary Systems	AUT18R5001	T	3	0	0	3
6	AUT18R5011	Automotive Systems Safety, Quality and Reliability	-	T	3	0	0	3
7	AUT18R5012	Vehicle Maintenance	-	T	3	0	0	3
8	AUT18R5013	Thermodynamics for IC Engineering	AUT18R5001	T	3	0	0	3
9	AUT18R5014	Artificial Intelligence Applications in Automotive Engineering	-	T	3	0	0	3
10	AUT18R5015	Finite Element Analysis for Automotive Systems	-	T	3	0	0	3
11	AUT18R5016	Modeling and Simulation of Automotive Systems	-	T	3	0	0	3
12	AUT18R5017	Computational Fluid Dynamics	-	T	3	0	0	3
13	AUT18R5018	Flow Visualization Techniques For I.C. Engines	AUT18R5001	T	3	0	0	3
14	AUT18R5019	Simulation of I.C. Engine Combustion Process	AUT18R5001	T	3	0	0	3
15	AUT18R5020	Internal Combustion Engine Design	-	T	3	0	0	3
16	AUT18R6001	Vehicle Dynamics and Structure	AUT18R5004	T	3	0	0	3
17	AUT18R6002	Heat Transfer Equipment Design	-	T	3	0	0	3
18	AUT18R6003	Advanced Heat Transfer	-	T	3	0	0	3
19	AUT18R6004	Mechatronics and Robotics	-	T	3	0	0	3
20	AUT18R6005	Automatic Control Engineering	-	T	3	0	0	3

21	AUT18R6006	Automotive Electrical And Electronics	-	T	3	0	0	3
22	AUT18R6007	Automotive Control Systems	-	T	3	0	0	3
23	AUT18R6008	Automotive Air Conditioning and Climate Control	-	T	3	0	0	3
24	AUT18R6009	Tribology in Design	-	T	3	0	0	3
25	AUT18R6010	Metal Forming for Automotive industries	AUT18R5001	T	3	0	0	3
26	AUT18R6011	Lean Burn Engines	AUT18R5001	T	3	0	0	3

5. Inter Disciplinary Electives

Sl.No.	Course Code	Course Name	Course Type	L	T	P	C
1	XXXXXXXXXX	Interdisciplinary Elective	IE	3	0	0	3
						Total	**3**

6. Mini Project

Sl.No.	Course Code	Course Name	Course Type	L	T	P	C
1	AUT18R5091	Mini Project	L	0	0	4	2
						Total	**2**

7. Project Work

Sl.No.	Course Code	Course Name	Course Type	L	T	P	C
1	AUT18R6098	Project Work Phase I		0	20	0	10
2	AUT18R6099	Project Work Phase II		0	32	0	16
						Total	**26**

8. Audit Courses

Sl.No.	Course Code	Course Name	Course Type	L	T	P	C
1	XXXXXXXXXX	Audit Course I	AC	2	0	0	0
2	XXXXXXXXXX	Audit Course II	AC	2	0	0	0
						Total	**0**

9. List of Interdisciplinary Electives (Offered to Other Disciplines)

Code	NameoftheSubject	L	T	P	C
AUT18R5021	InternalCombustionEngineeringFundamentals	3	0	0	3
AUT18R5022	Advanced I.C Engines	3	0	0	3
AUT18R5023	Fuels and Combustion	3	0	0	3
AUT18R5024	ManufacturingofAutomotiveComponents	3	0	0	3
AUT18R5025	Welding Technology	3	0	0	3
AUT18R5026	Automotive Electronics	3	0	0	3

10. List of General/Open Electives

Sl. No	CODE	Name ofTheSubject	L	T	P	C
1	EEE18R5020	Soft Computing Techniques	3	0	0	3
2	EEE18R6013	Evolutionary Computation Techniques	3	0	0	3
3	EEE18R5021	Optimization Techniques	3	0	0	3
4	CSE18R5051	Cloud Computing	3	0	0	3
5	CSE18R5052	IOT And Applications	3	0	0	3
6	CSE18R5053	Big Data Analytics	3	0	0	3
7	XXXXXXXX	Business Analysis	3	0	0	3
8	XXXXXXXX	Industrial Safety	3	0	0	3
9	XXXXXXXX	Operation Research	3	0	0	3
10	XXXXXXXX	Cost Management of Engineering	3	0	0	3
11	XXXXXXXX	Composite Materials	3	0	0	3
12	XXXXXXXX	Waste to Energy	3	0	0	3

11. List of Audit Courses

Sl. No	CODE	Name ofTheSubject	L	T	P	C
1	XXXXXXXX	English for Research Paper Writing	2	0	0	0
2	XXXXXXXX	Disaster Management	2	0	0	0
3	XXXXXXXX	Sanskrit for Technical Knowledge	2	0	0	0
4	XXXXXXXX	Value Education	2	0	0	0
5	XXXXXXXX	Constitution of India	2	0	0	0
6	XXXXXXXX	Pedagogy Studies	2	0	0	0
7	XXXXXXXX	Stress Management by Yoga	2	0	0	0
8	XXXXXXXX	Personality development through Life Enlightenment Skill	2	0	0	0

SEMESTER I

Course Code	Course Name	Course type	L	T	P	C
MAT18R5002	Statistics and Computational Techniques	SC	3	0	0	3
AUT18R5001	Vehicle Engine Technology	T	3	0	1	3
AUT18R5002	Automotive Materials and Metallurgy	T	3	0	1	3
AUT18R5003	Manufacturing and Testing of Automotive Components	T	3	0	1	3
AUT18RXXXXX	Program Elective I	PE	3	0	0	3
AUT18R5081	Computer Aided Vehicle Design and Analysis	L	0	0	3	2
PGM18R5001	Research Methodology	SC	1	0	0	1
XXXXXXXXX	Audit Course I	AC	2	0	0	0
					Total	**18**

SEMESTER II

Course Code	Course Name	Course type	L	T	P	C
AUT17R5004	Automotive Chassis and Body Engineering	T	3	0	1	3
AUT18R5005	Automotive Transmission System	T	3	0	1	3
AUT18RXXXX	Program ElectiveII	PE	3	0	0	3
AUT18RXXXX	Program Elective III	PE	3	0	0	3
AUT18R5082	Automotive and Autotronics Laboratory	L	0	0	3	2
AUT18R5083	Combustion and Emission Analysis Laboratory	L	0	0	3	2
XXXXXXXXX	Audit Course II	AC	2	0	0	0
AUT18R5091	Mini Project		0	0	4	2
					Total	**18**

SEMESTER III

Course Code	Course Name	Course type	L	T	P	C
AUT18RXXXX	Program Elective IV	PE	3	0	0	3
AUT18RXXXX	Program Elective V	PE	3	0	0	3
XXXXXXXXXX	Interdisciplinary Elective	IE	3	0	0	3
AUT18R6098	Project Work Phase I		0	0	20	10
					Total	**19**

SEMESTER IV

Course Code	Course Name	Course type	L	T	P	C
AUT18R6099	Project Work-Phase II		0	0	32	16
					Total	**16**

Total Credits: 71

I - SUPPORTIVE COURSES

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MAT18R5002	Statistics and Computational Techniques	L	T	P	C
		3	0	0	3

PROBABILITY DISTRIBUTIONS

Probability basic concepts - Binomial, Poisson, Geometric, Normal, Uniform, Exponential, Gamma and Weibull - distributions - Mean, Variance, Moment generating functions.

CORRELATION AND REGRESSION ANALYSIS:

Bivariate correlation – correlation in multivariate systems; Bivariate linear regression – statistical optimization – principle of least squares – reliability of the regression equation – reliability of point estimates of regression coefficients – confidence interval of the regression equation – correlation versus regression - Multiple Regression Analysis: Matrix solution of the standardized model - criteria for evaluating a multiple regression model – Analysis of residuals

ESTIMATION THEORY

Estimation of parameters - Principles of least squares - Maximum likelihood estimation - Method of moments - Interval estimation

TESTING OF HYPOTHESIS

Sampling distribution, Large sample tests - Mean and Proportion, Small sample tests - t - test , F- test and Chi-Square test.-Goodness of fit -Independence of attributes.

DESIGN OF EXPERIMENTS

Design of Experiments: Basic Designs, Factorial Design, ANOVA

Text Book(s):

1. Jay, L. Devore, Probability and Statistics for Engineering and Sciences, Brooks Cole Publishing Company, Monterey, California, 1982.
2. Gupta, S.C. and Kapoor, V.K, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 11th Edition.
3. Paul Mac Berthouex and Linfield C. Brown, “Statistics for Environmental Engineers”, Second Edition, Lewis Publishers, Washington D.C. , 2002

References:

1. Trivedi, K.S., Probability and Statistics with Reliability, Queuing and Computer Science Applications,PHI.
2. Kapur, J.N. and Saxena, H.C, Mathematical Statistics, S.Chand and Co. Ltd., 18th Revised Edition, 1997.
3. Douglas C. Montgomery, Design and analysis of experiments, John Wiley and sons, 7th edition, 2010.

PGM18R5001	RESEARCH METHODOLOGY	L	T	P	C
		1	0	0	1

INTRODUCTION

Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.

QUANTITATIVE METHODS FOR PROBLEM SOLVING

Statistical modeling and analysis, time series analysis probability distributions, Fundamentals of statistical analysis and interference, multivariate methods, concepts of correlation and regression, fundamentals of time series, analysis and spectral analysis, error analysis, applications of spectral analysis.

DATA ANALYSIS

Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, relation between frequency distributions and other graphs, preparing data for analysis.

SOFT COMPUTING APPLICATION

Computer and its role in research, Use of statistical software SPSS, GRETL etc in research. Introduction to evolutionary algorithms- fundamentals of genetic algorithms, simulated annealing, and neural network based optimization, optimization of fuzzy systems.

REPORT WRITING

Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing

TEXT BOOKS

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, VishwaPrakashan, 2006
2. Donald H.McBurney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047-0,2006

REFERENCE BOOKS

1. Donald R.Cooper, Pamela S.Schindler, Business Research Methods, 8/e, Tata McGraw Hill Co.Ltd. 2006.
2. Fuzzy Logic with Engg Applications, Timothy J.Ross, Wiley Publications, 2nd Ed[d].
3. Simulated Annealing: Theory and Applications (Mathematica and its applications, by P.J.VanLaarhoven&E.H.Aarts[e]
4. Genetic Algorithms in search, optimization and machine learning by David E Goldberg

II - CORE COURSES

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AUT18R5001	VEHICLE ENGINE TECHNOLOGY	L	T	P	C
		3	0	1	4

ENGINE BASIC THEORY

Engine construction and their operation – Classification – Operating cycles of S.I. and C.I. engines Engine Subsystems: Ignition system – Conventional and Electronic, Cooling systems – radiator types and Lubricating systems Performance Testing of engines: Volumetric efficiency - Friction Power measurement - Performance curves for SI and CI engines - Heat balance – Performance maps.

FUEL SUPPLY SYSTEMS – SI ENGINES

Mixture requirements – Theory of carburetion – Simple Carburetor - Modern Carburetor – Carburetor types – Drawbacks of carburetor. Petrol injection systems – Types – Components of Fuel Injection systems – Electronic Engine Control – Injection Strategies – Air flow metering – Operational modes – Working principle of TBI, D-Jetronic, L-Jetronic, K-Jetronic, KE-Jetronic systems and Gasoline Direct Injection(GDI) systems

FUEL SUPPLY SYSTEMS – CI ENGINES

Functional requirements – Components – Injector Nozzle control – Injection types: Unit, Unit Pump and Common Rail systems – Injection Pumps – Injectors: Pintle, Pintaux and Orifice types – Electro Hydraulic Injectors: Solenoid and Piezo actuated. Advance Injection Systems: Common Rail Direct Injection (CRDI) systems – HEUI systems – Cummins HPITP systems – Xtreme Pressure Injection (XPI) systems

COMBUSTION IN ENGINES

Types of combustion – Combustion in SI engines: Phases of Spark Ignition – Stages of Combustion – Flame development – Flame Structure – Flame Propagation – Abnormal Combustion – Factors affecting knocking Combustion in CI engines: Stages of combustion – Factors affecting ignition delay – Spray Characteristics: Cavitation, Spray penetration, Spray Atomization, Spray Evaporation and Droplet Distribution – Abnormal Combustion

AIR INDUCTION SYSTEMS AND COMBUSTION CHAMBERS

Charge Motion: Intake Jet Flow – Turbulence – Swirl – Swirl Generation – Squish Charging Systems: Super chargers and Turbo Chargers – Types and working - Boost control - Charge cooling. Combustion Chambers: Requirements – Design considerations – Swirl ratio and Surface to Volume ratio – SI engine combustion chambers – CI Engine combustion chambers – Open and IDI types

Practical Component

1. Analyze the heat transfer characteristics of different radiator fluid.
2. Conduct and draw the heat balancing diagram for diesel engine
3. Performance and Emission characteristics of Split injected CI Engine.
4. Effect of injection pressure on Diesel Engine Performance.
5. Analyze the performance and emission parameters of diesel engine at different fuel injection timings.

Reference Books

1. V.Ganesan, 'Internal Combustion Engines' McGraw Hill Book Co, 4th Edition, 2017.
2. Richard Stone, 'Introduction of Internal Combustion Engines', MacMillan, 4th Edition, 2012.
3. Klaus Mollenhauer and Helmut Tschoeke, 'Handbook of Diesel Engines' Springer, 2010.
4. Robert Bosch, 'Automotive Hand Book', SAE, 8th Edition, 2007.
5. Heinz Heizler, 'Advanced Engine Technology'. Butterworth Heinemann, 1998.
6. John.B. Heywood, 'Internal Combustion Engine Fundamentals' McGraw Hill Book Co, 2017.

AUT18R5002	AUTOMOTIVE MATERIALS AND METALLURGY	L	T	P	C
		3	0	1	4

ELASTICANDPLASTICBEHAVIOUROFMATERIALS

Elastic forms - stress and strain relationship in engineering materials-iron carbon diagram - deformation mechanism - plastic stress strain relations -slip line field theory–dislocation theory-strengthening mechanisms- strain hardening, alloying, polyphasemixture,martensiticprecipitation,dispersionhardening,fiberand texture strengthening-preferred orientation.

FAILUREOFMATERIALS

Fracture, classification and types, Griffith's theory - notch effects, stress concentration- concept of fracture toughness-metallographic aspects of fracture –fractography, ductile brittle transition–fatigue-mechanism of crack in itiation and growth-fatigue under combined stresses, factors affecting fatigue–creep-creep curve, creep mechanism, metallurgical variables of creep-super plasticity.

CHARACTERISTICSOFMATERIALS

Castability,machinability,formabilityandweldingofengineeringmaterialssuchas steel,castiron,alloysteels,brass,bronzeandaluminumalloy- behaviourofmaterialsfor high temperature – wear and corrosion resistance application- residual stress analysis by diffraction methods - metallurgical characterization of automotive materials.

SELECTIONOFMATERIALS

Criteriaofselectingmaterialsforautomotivecomponentsvizcylinderblock,cylinder head,piston,pistonring,gudgeonpin,connectingrod,crankshaft,crankcase,cam, cam shaft, engine valve, gearwheel, clutch plate, axle, bearings, chassis, spring, radiator,brakeliningetc-applicationofnon-metallicmaterialssuchascomposite, ceramicandpolymersinautomobilecomponents.

HEATTREATMENTANDSURFACETREATMENT

Heat treatment of steel - annealing, normalizing,hardeningand tempering with specificrelevancetoautomotivecomponents,surfacehardeningtechniques,inductionandflameharden ing- coatingforwearandcorrosionresistance,electroplating, electrolessplating,phospating,anodizing,thermalspraying,hardfacingand thin film coatings.

Practical Components

1. Surface roughness measurement of metals.
2. Heat treatment studies on ferrous and non-ferrous metals.
3. Failure mode effective analyse on automotive structural components.
4. Thermography studies on heat treated alloys.
5. Metallurgical case studies on corrosion, wear and high temperature in automotive applications.

References

1. R.K. Rajput, Engineering Materials & Metallurgy, S. Chand Limited, 2006.
2. K.I. Parashivamurthy, Material Science and Metallurgy, Pearson, 2012.
3. U.C. Jindal, Material Science and Metallurgy, Pearson, 2012.
4. R. Balasubramaniam, Callister's Materials Science and Engineering 2 Edition, Wiley, 2014.

AUT18R5003	MANUFACTURING AND TESTING OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	1	4

INTRODUCTION TO MANUFACTURING TECHNIQUES

Casting, types of casting process, forging process, forming operations, machining techniques, heat treatment, surface hardening, CNC, high energy rate forming process and other secondary operations.Precisionandmicromachining-diamondturningofpartstonanometeraccuracy– stereomicrolithographymachiningofmicrosizedcomponents.

MANUFACTURING OF ENGINE COMPONENTS

Manufacturing of connecting rod, crankshaft, cam shaft, engine block, cylinder head, piston, piston rings and pin, carburetors, inlet and exhaust valve, productionofpushrod,rockerarmandtappets, injector assembly, case study.

MANUFACTURING OF TRANSMISSION AND AXILLARY SYSTEMS

Clutch, flywheel, Gear train, universaljoint, differential, main axle, stub axle, wheels, brakes, suspension systems, leaf spring, coil spring, propeller shaft, case study.

TESTINGINSTRUMENTAL TECHNIQUES

FTIR spectrometer, Thermal analyzer, X-ray analyzer, Optical emission spectroscopy, Gas and Liquid Chromatography, High strain rate tester, Non- destructive instruments, New innovations in testing and characterization, X-ray Diffraction, Electron microscope (SEM, TEM), Scanning probe microscopy (SPM, AFM), Spectroscopic methods (EDS, FTIR); Mechanical behaviors, Thermal response, Chemical resistance and Electrical-Magnetic-Optical properties.

QUALITYANDTESTING

Introductionto ISO9000,ISO14000,QS9000,itsimportance,BIScodesfortestingvarioustypesofengines,equipmentrequired,instrumentationandcomputeraidedenginetesting,metrologyformanufacturingI.C.enginecomponents.

Practical Components

1. Tensile and hardness testing of automotive components according to ASTM standards.
2. Residual stress measurement in automotive components with the help of XRD method.
3. Chemical and mechanical characterization of newer materials used for automotive applications.
4. Fatigue analysis on leaf spring, connecting rod, valves and other components.
5. Wear studies on automotive components with an aid of pin-on-disc apparatus.

Reference

1. SeropeKalpakjian,'ManufacturingEngineeringandTechnology', Pearson; 7th Edition, 2013.
2. Yang Leng, 'Material Characterization: Introduction to Microscopic & Spectroscopic Methods, John Wiley Pvt Ltd, 2013.
3. Rajan.T.V.'Heat Treatment Principles and Techniques', Prentice- Hall of India Pvt. Ltd., 2nd Edition, 2010.
4. ASM Handbook on Metals Handbook: Volume: 8Mechanical Testing and Evaluation, 1978.

AUT18R5081	COMPUTERAIDEDVEHICLEDESIGN LABORATORY	L	T	P	C
		0	0	3	2

1. Design of piston, piston pin and piston rings and drawing of these components.
2. Designingofconnectingrod,smallendandbigendshankdesign,designof bigendcrankarms,anddrawingoftheconnectingrodassembly.
3. Design ofcrankshaft,balancingweightcalculations, developmentofshortand long crank arms, front end and rear end details, drawing crankshaft assembly.
4. Designanddrawingofflywheel,ringgeardesign,drawingoftheflywheelincludingofringgear teeth.
5. Designanddrawingofinletandexhaustvalves.
6. DesignanddrawingofCamandCamShaft.
7. DesignofCombustionChamber.
8. Design anddrawingofEngineCompleteassemblyinvolvedwithcylinderblock,cylinderhead,cr ankcase,valveports,waterjackets,frontand rear end details.
9. Completedesignofclutchcomponents.Componentsandassemblydrawing.
10. Geartraincalculations,LayoutofGearbox.Calculationofbearingloadsandselectionofbe arings.Completeassemblydrawingusingdraftingsoftware.

AUT17R5082	AUTOMOTIVEANDAUTOTRONICS LABORATORY	L	T	P	C
		0	0	3	2

Automobile Laboratory:

- Performancetestona4strokeengine.
- Viscositydeterminationofagivenfluid.
- Momentofinertiaforconnectingrod.
- Determinationofeffectivenessofaparallelandcounterflowheatexchangers.
- Valvetimingof4strokeandporttimingof2strokeengine.
- Performanceteston2strokeengine.
- MeasurementofHC,CO,CO_2,O_2usingexhaustgasanalyzer.
- Dieselsmokemeasurements.

AutotronicsLaboratory:

- Studyofrectifierandfilters.
- Characteristicsofamplifiers.
- Studyoflogicgates,addressandflip-flops.
- StudyofSCRandICtimer.
- D/AandA/Dconverter.
- Assemblylanguageprogrammingexercise.
- InterfacingA/Dconverterandsimpledataacquisition.
- InterfacingsteppermotorcontrolandCRTterminal.
- Microcontrollerprogrammingandinterfacing

AUT18R5083	Combustion and Emission Analysis Laboratory	L	T	P	C
		0	0	3	2

List of Experiments:

1. Performance and Emission Characteristics of CI Engine

2.Performance and Emission Characteristics of SI Engine

3. Performance improvement and emission control of I.C engines

4. Use of alternative fuels in I.C engines

5. Engine design modifications for Emission control

6. Flow visualization using advanced optical techniques

7. HCCI, GDI and other recent I.C engine developments

8. Combustion characteristics of different fueled CI Engine

AUT17R5004	AUTOMOTIVE CHASSIS AND BODY ENGINEERING	L	T	P	C
		3	0	1	4

CHASSISSTRUCTURALDESIGN

Chassisstructuraldesign,varioustypesofframes, superstructure,constructionaldetails,materials, properties, weight reduction, structural efficiency loading, torsional, bending, stiffness,loadinputpoints,static/dynamicloads– crashworthiness,rollerprotection, driverprotection.

VEHICLEBODYENGINEERING

Body details – car, bus, commercial vehicles – selection and properties of body materials,trimandmechanisms.

VEHICLEAERODYNAMICS

Generation of aerodynamic loads onvehicles –roadloadsduetoaerodynamicforces– aerodynamicdesignofvehicles– loadtransferduetocornering– rollover stability– vehicledragandvariousbodyoptimizationtechniquesforminimumdrag– types of forces, moments and effects – wind tunnel testing, scaling, measuring techniques– componentbalancetomeasureforcesandmoments.

SUSPENSIONSYSTEM

Typesandapplications–materialforspring- stress– deflectionequationforhelicalspring,Wahlcorrectionfactor–designofhelicalsprings–tensionsprings– buckling of spring– springs inparallelandinseries - analysisofsuspensionsystem:Kinematicanalysis–compliances,non-lineareffects– effectofspringanddampers onsteadystateandtransienthandling–forcesinmembers.

AUTOMOTIVE BRAKES

Overview of brake system - designconsideration in brakes – band - internal expanding shoe-external contracting, longandshort-energy equation -thermal considerationandratingofbrakes.

Practical Component

1. Tension and impact test on mild steel rod
2. Double shear test on Mild steel rods
3. Torsion test on mild steel rod
4. Dismantling and assembly of steering system
5. Dismantling and assembly of Differential.

References

1. Kirpalsingh, automobile engineering vol-1, standard publishers distributors, India ,2017
2. Andrew Livesey, Alan J.A. Robinson,The Repair of Vehicle Bodies, routledge, 2013
3. Pouloski,J,VehicleBodyEngineering,BusinessBooksLtd.,1989.
4. Hocho,E.H.(Ed),Aerodynamicsofroadvehicles,SAE,(4^{th}Edition),1998
5. Adams,H.,ChassisEngineering,H.P.Berks,1993.
6. Gillespie,T.D.,Fundamentalsofvehicledynamics,SAE,1992.

AUT18R5005	AUTOMOTIVETRANSMISSIONSYSTEM	L	T	P	C
		3	0	1	4

CLUTCHESANDGEARBOX

Design requirements of friction clutches - selection criteria-torque transmission capacity - single plate clutch-multiple plate clutch-lining material - fluid coupling- design considerationof gearbox-selectionofpropergearratioforanautomobilegearbox- designofshafts-splinesandgears,designofgearandshaftforgearbox-different typesofgearboxes-performancecharacteristics.

AXLES,PROPELLORSHAFTS,FINALDRIVEANDDIFFERENTIAL

Designoffrontandrearaxlesforautomobiles-rearaxleshousing-designofpropellorshaftsforbending torsionandrigidity,universaljointsandslipjoints-differenttypesofdrives-worm andwormwheel-bevelandhypoidgearfinaldrives-doublereductionandtwinspeedfinaldrives-differentialprinciples-constructiondetailsofdifferentialunits- nonslipdifferential-differentiallocks-differentialhousings.

HYDROSTATICDRIVESANDELECTRICALDRIVES

Hydrostaticdrives-varioustypesofhydrostaticsystems-principlesofhydrostatic drivesystems-advantagesandlimitations- comparisonofhydrostaticwithhydrodynamic drives - construction and working of typical hydrostatic drives - electrical drives -principles and design-advantages and limitations -performance characteristics.

AUTOMATICTRANSMISSON

Semi-automatictransmissionforcarsandheavyvehicles-layoutandoperation- automatic transmission -advantages, basic construction and operation -automatic transmission for passenger cars - hydraulic operation - continuous variable transmission- operatingprinciple-basiclayoutandoperation-advantagesand limitations.

AUTOMATIC TRANSMISSION APPLICATIONS

Chevrolet "Turboglide" transmission.Toyota's Automatic transmission with Electronic control system. Continuously Variable Transmission (CVT) – types – Operations.

Practical Components

1. Determine the gear ratio of the Sliding Mesh/Synchromesh Gear Box.
2. Dismantling and assembly of single plate clutch
3. Dismantling and assembly of Multi plate clutch
4. Dismantling and assembly of Sliding Mesh Gear Box.
5. Dismantling and assembly of synchromesh Gear Box.

References

1. Heinz Heisler, 'Advanced Vehicle Technology',2nd edition, Butterworth – Heinemann, 2002.
2. N. K. Giri, 'Automobile Mechanics', 7th Edition, Khanna Publishers, 2008.
3. K. Newton, W.Steeds, T.K.Garret, 'The Motor Vehicle', 13th Edition, Butterworth Heinemann, 2004.
4. Grouse. W. H, 'Automotive Chassis and Body', McGraw Hill, 1971.

AUT17R5084	AUTOMOTIVEANDAUTOTRONICS LABORATORY	L	T	P	C
		0	0	3	2

Automobile Laboratory:

- Performancetestona4strokeengine.
- Viscositydeterminationofagivenfluid.
- Momentofinertiaforconnectingrod.
- Determinationofeffectivenessofaparallelandcounterflowheatexchangers.
- Valvetimingof4strokeandporttimingof2strokeengine.
- Performanceteston2strokeengine.
- MeasurementofHC,CO,CO_2,O_2usingexhaustgasanalyzer.
- Dieselsmokemeasurements.

AutotronicsLaboratory:

- Studyofrectifierandfilters.
- Characteristicsofamplifiers.
- Studyoflogicgates,addressandflip-flops.
- StudyofSCRandICtimer.
- D/AandA/Dconverter.
- Assemblylanguageprogrammingexercise.
- InterfacingA/Dconverterandsimpledataacquisition.
- InterfacingsteppermotorcontrolandCRTterminal.
- Microcontrollerprogrammingandinterfacing

III – PROGRAM ELECTIVE

AUT18R5006	SUPERCHARGINGANDSCAVENGING	L	T	P	C
		3	0	0	3

SUPERCHARGING

Objectives- effectsonengineperformance-enginemodificationrequired- thermodynamics ofsupercharging and turbocharging-turbocharging methods-engineexhaustmanifoldsarrangements-Limitations of supercharging.

SUPERCHARGERS

Typesofcompressors -positivedisplacements blowers-centrifugal compressors - performancecharacteristic curves - suitability for engine application – surging - matchingofcompressors,turbineengine.

SCAVENGINGOFTWOSTROKEENGINES

Peculiarities of two stroke cycle engines - classification of scavenging systems - mixturecontrolthroughreedvalveinduction- chargingprocessintwostrokecycleengine – terminologies -Shankeydiagram -relation between scavenging terms - scavenging modeling - perfectdisplacement, perfect mixing-complex scavenging models.

PORTSANDMUFFLERDESIGN

Porting-designconsiderations-designofintakeandexhaustsystems-tuning.

EXPERIMENTALMETHODS

Experimentaltechniquesforevaluatingscavenging- firingenginetests-nonfiringenginetests-portflowcharacteristics-Kadenacysystem-orbitalenginecombustionsystem-sonicsystem.

References

1. John. B. Heywood, 'Two-Stroke Cycle Engine: It's Development, Operation and Design',CRC Press,1999.
2. RichardStone,'InternalCombustionEngines',SAE,1992.
3. Vincent,E.T.,'SuperchargingtheI.C.Engines',McGraw-Hill, 1943.
4. WatsonandJanota,M.S.,'TurboChargingtheI.C.Engines',MacmillanCo. 1982.
5. Schweitxer,P.H.,'ScavengingoftwoStrokeCycleDieselEngine',Macmillan Co.,1984.

AUT18R5007	ALTERNATIVE FUELS FOR IC ENGINES	L	T	P	C
		3	0	0	3

INTRODUCTION

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Ethanol, Methanol, Diethyl ether, Dimethyl ether, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Bio-gas and Bio-diesel.

LIQUID FUELS FOR S.I. ENGINES

Requirements, Utilisation techniques – Blends, Neat form, Reformed Fuels, Storage and Safety, Performance and Emission Characteristics

LIQUID FUELS FOR C.I. ENGINES

Requirements, Utilisation techniques - Blends, Neat fuels, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and Additives, Performance and emission characteristics.

GASEOUS FUELS FOR S.I. ENGINES

Hydrogen, Compressed Natural gas, Liquefied Petroleum gas, and Bio gas in SI engines – Safety Precautions – Engine performance and emissions.

GASEOUS FUELS FOR C.I. ENGINES

Hydrogen, Biogas, Liquefied Petroleum gas, Compressed Natural gas in CI engines.Dual fuelling,-Performance and emission characteristics.

References

1. Vinay Kumar, 'Performance and Modelling of IC Engine fuelled with Biodiesel – Potential of Automotive Fuel', Lambert Academic Publishing, 2016.
2. Thipse.S.S, 'Alternative fuels', Jaico Book Distributors, 2010.
3. Osamu Hirao, Richard K Pefley, 'Present and Future Automotive Fuels', John Wiley, 1988.
4. Keith Owen, Trevor Eoley, 'Automotive Fuels Handbook', SAE Publications,1990.

AUT18R5008	COMBUSTION AND EMISSION IN ENGINES	L	T	P	C
		3	0	0	3

COMBUSTION PRINCIPLES

Combustion – Combustion equations, heat of combustion - Theoretical flame temperature – chemical equilibrium and Dissociation -Theories of Combustion - Flammability Limits - Reaction rates - Laminar and Turbulent Flame Propagation in Engines.

COMBUSTION IN S.I. ENGINES

Stages of combustion, normal and abnormal combustion, knocking, Variables affecting Knock, Features and design consideration of combustion chambers.Flame structure and speed, cyclic variations, Lean burn combustion, Stratified charge combustion systems.Heat release correlations.

COMBUSTION IN C.I. ENGINES

Stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, Features and design considerations of combustion chambers, delay period correlations, heat release correlations, Influence of the injection system on combustion, Direct and indirect injection systems.

COMBUSTION IN GAS TURBINES

Flame stability, Re-circulation zone and requirements - Combustion chamber configurations, Cooling, Materials.

EMISSIONS

Carbon monoxide, Unburnt Hydrocarbons, Oxides of Nitrogen, Particulate matter and smoke – sources. Emission control measures for SI and CI engines. Effect of emissions on environment and human beings.

References

1. B.P.Pundir, 'I.C. Engines Combustion and Emission',Narosa Publishing House, 2017.
2. Ramalingam, K.K, 'Internal Combustion Engines', SciTech Publications Pvt Ltd., 2016.
3. V.Ganesan, 'Internal Combustion Engines' McGraw Hill Book Co, 4th Edition, 2017.
4. John. B. Heywood, 'Internal Combustion Engine Fundamentals' McGraw Hill Book Co, 2017.
5. Mathur. M.L.Sharma, R.P, 'A Course in Internal Combustion Engines', DhanpatRai Publications, 2014.

AUT18R5009	ENGINE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

AIR POLLUTION - ENGINES AND TURBINES

Atmospheric pollution from Automotive and Stationary engines and gas turbines, Global warming – Green-house effect, effects of engine pollution on environment, effects of engine pollution to human

POLLUTANT FORMATION

Formation of oxides of nitrogen, carbon monoxide, hydrocarbon, aldehydes and Smoke, Particulate emission. Effects of Engine Design - operating variables on Emission formation - Design Variables on Emission Formation – Noise pollution.

EMISSION MEASUREMENT TECHNIQUES

Non dispersive infrared gas analyser, gas chromatography, chemiluminescentanalyser and flame ionization detector, smoke meters, Gas Analyzer – Noise measurement and control.

EMISSION CONTROL TECHNIQUES

Engine Design modifications, fuel modification, evaporative emission control, EGR, air injection, thermal reactors, Water Injection, catalytic converters, application of microprocessor in emission control. Common rail injection system, Particulate traps, NOx converters, SCR systems. GDI and HCCI concepts.

DRIVING CYCLES AND EMISSION STANDARDS

Transient dynamometer, Test cells, Driving cycles for emission measurement, chassis dynamometer, CVS system, National and International emission standards.

References

1. B. P. Pundir, 'Engine Emissions: Fundamentals and Advances in Control', 2nd Edition, Narosa publishing, 2017.
2. John. B. Heywood, 'Internal Combustion engine fundamentals', McGraw – Hill, 2017.
3. Crouse William, 'Automotive Emission Control', McGraw-Hill,1980.
4. Ernest S, Starkman, 'Combustion Generated Air Pollutions', Plenum Press, 1980.
5. George S Springer, Donald J.Patterson, 'Engine emissions: Pollutant Formation and Measurement', Plenum press, 1973.
6. Obert, E.F, 'Internal Combustion Engines and Air Pollution', Harper & Row Publishers, 3rdEdition, 1973.

AUT18R5010	ENGINE AUXILIARY SYSTEMS	L	T	P	C
		3	0	0	3

CARBURETION

Gasoline - air mixtures. Mixture requirements - Mixture formation - Carburettor, Choke, Carburettor systems for emission control- Secondary Air Injection.

GASOLINE INJECTION AND IGNITION SYSTEMS

Petrol Injection - Pneumatic and Electronic Fuel Injection Systems, Ignition systems - Requirements, Timing Systems, Energy requirement, Spark plug operation, Electronic &Distributorless Ignition Systems.

DIESEL FUEL INJECTION SYSTEMS

Atomisation, penetration and dispersion, Rate and duration of injection, Fuel line hydraulics, Fuel pump, Injectors, CRDI Governors.

INTAKE AND EXHAUST MANIFOLDS

Intake system components, Air filter, Intake manifold, VGT, VNT, Exhaust manifold and exhaust pipe, Exhaust mufflers & Resonators.

LUBRICATION AND COOLING SYSTEMS

Lubricating systems- Theory, requirements and types, Lubrication - piston rings, crankshaft bearings, camshaft, Cooling systems – Need, Engine heat transfer, liquid and air cooled engines, Oil cooling, Additives and lubricity improvers.

References

1. V.Ganesan, 'Internal Combustion Engines' McGraw Hill Book Co, 4th Edition, 2017.
2. Eric Chowanietz, 'Automobile Electronics', SAE International, 1995.
3. Heinz Heisler, 'Advanced Engine Technology', Butterworth Heinmann Publishers, 2nd Edition, 2002.
4. Duffy Smith, 'Auto Fuel Systems', Good Heart Wilcox Company Inc, Publishers, 1987.

AUT18R5011	AUTOMOTIVESYSTEMSSAFETY, QUALITYANDRELIABILITY	L	T	P	C
		3	0	0	3

SAFETYMANAGEMENTPRACTICESINAUTOMOTIVEINDUSTRIES

Needforsafety-safetyconcepts–safetymanagementfunctions–safetycommittee- safety auditandsurvey- safety inspection –safety sampling -jobsafety analysis - damagecontrol-disastercontrol–emergencypreparednessplan-accidenttypes– causesandcostofaccidents-housekeeping–safetyeducationandtraining-accident reporting -accident investigation –accident prevention programs -firstaid-firefighting-personalprotectiveequipments.

SAFETYSYSTEMANALYSIS

Introduction–definitions-safetysystems- safetycontrolsystems-organizationsandmanagement of safety - safety information system, basic concepts, information sources, codingsources, documentation, processing ofinformation -safety budgetallocation-costbenefitanalysis-allocatingthebudget-totallosscontrol–benefits.

HAZARDSANDRISKSINAUTOMOTIVEINDUSTRIES

Introduction –hazard -risk–safety analysis -riskassessment -Techniques and methodologiesforriskanalysis–checklist- whatifanalysis-HazardandOperabilityStudies(HAZOP)-FaultTreeAnalysis(FTA)- EvenTreeAnalysis(ETA)- Failure Mode EffectAnalysis (FMEA) – Material Safety DataSheet(MSDS) -computer aidedhazard analysis -expertsystemandartificial intelligence application -fault detectionanddiagnosis.

TRANSPORTSAFETY

introduction -factors forimproving safety onroads -causes of accidents due to driversandpedestrians –safetyindesign,selection,operationandmaintenanceof transport vehicles - preventive maintenance –servicing -check list -insurance - Transportemergencycard(TREM)-warningsymbols-responsibilityofdriver- transportprecaution- safedriving-historyoflegislationsrelatedtosafety-safety provisionsinthefactoryact-indianmotorvehiclesactandrules- workmen compensationact-ESIact-OSHAstandards.

RELIABILITYANDQUALITY

Reliability– reliabilityfunction–MTBF- MTTF-mortalitycurve-availability– maintainability-failure data analysis – repair time distributions - graphical evaluation- reliabilityprediction-failurerateestimates-effectofenvironmentandstress-seriesandparallelsystems -RDBanalysis – standby systems -complex systems- totalqualitymanagement–QCTools–qualitycircles–qualityfunctiondeployment– 5S– Kaizen– Sixsigma– qualitymanagementsystem–ISO–implementationsteps.

References

1. AccidentPreventionManualforIndustrialOperations,NSC,Chicago,1982.
2. Babkov.V.F, ‘ Roadconditionsandtrafficsafety’,MIRPublications,Moscow,1986.
3. Dhillon.B.S, Singh.C, ‘ Engineering Reliability- New Techniques and Applications’ ,JohnWiley,1981.
4. ErnestJ.Henley, HiromitsuKumamoto, ‘ Designingforreliabilityandsafetycontrol’,PrenticeHall,1985.

AUT18R5012	VEHICLEMAINTENANCE	L	T	P	C
		3	0	0	3

MAINTENANCERECORDSANDSCHEDULE

Importanceofmaintenance-scheduledandunscheduledmaintenance- preparationofchecklist-chassislubrication-costeffectiveness -pre-trip,inspectionform-log books,tripsheets-othermaintenancerecordform.

MAINTENANCEOFENGINE

Dismantlingofenginecomponents- cleaningmethods-visualinspectionanddimensionalcheckofvariousenginecomponents-minorandmajortuneup, reconditioning, repairingmethodsofenginecomponents- assembly procedure-specialtoolsusedformaintenance,repairandoverhauling.

MAINTENANCEOFCHASSISDRIVELINECOMPONENTS

Clutch-mechanical, automatic types-gearbox-mechanical, automatictypes-final reduction-propellorshaft-frontandrearsuspensionsystem- rigidandindependenttypes- brakessystems-hydraulic,servo,air-airbleeding-steeringsystem- wheel alignment-tyres.

MAINTENANCEOFELECTRICALSYSTEMS

Battery - testing methods - starter motor - charging system-dc generator, ac alternator, ignition system - coil ignition, transistor assisted ignition, capacitor dischargeignition-electrichorn,wiper,flasher,electricfuelpumps,gauges,lightingsystem,headlightfocusing,wiringsystem.

MAINTENANCE OFCOOLINGSYSTEM,LUBRICATION SYSTEM,FUEL SYSTEMANDBODY

Coolingsystem-types,waterpumps,radiator,thermostatvalve-anticorrosionand anti-freezingsolutions- lubricatingsystem-oilanalysis,oiltoppingup,oilchange,oilfilters,oilreliefvalve-fuelsystem-petrol,dieselfuelfeedsystemcomponents- body repairtools,minorbodypanelbeating,tinkering,soldering,polishing,painting- door locksmechanism-windowglassactuatingmechanism.

References

1. JohnDoke,Fleetmanagement,Mc-GrawHillCo,1984.
2. Maleev,V.L.,Dieselengineoperationandmaintenance,Mc-GrawHillBook Co,NewYork,1984.
3. Leslie FGoing,Automotivemaintenance and trouble shooting, American TechnicalSociety,1972.

AUT18R5013	THERMODYNAMICS FOR IC ENGINEERING	L	T	P	C
		3	0	0	3

THERMODYNAMIC PROPERTY RELATIONS

Thermodynamic Potentials, Maxwell relations, Generalised relations for changes in Entropy, Internal Energy and Enthalpy, Generalised Relations for Cp and Cv, ClausiusClayperon Equation, Joule- Thomson Coefficient, Bridgeman Tables for Thermodynamic Relations.

REAL GAS BEHAVIOUR AND MULTI-COMPONENT SYSTEMS

Equations of State (mention three equations), Fugacity, Compressibility, Principle of Corresponding States, Use of generalised charts for enthalpy and entropy departure, fugacity coefficient, Lee-Kesler generalised three parameter tables. Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, Ideal solution of real gases and liquids, Equilibrium in multi-phase systems, Gibbs phase rule for non-reactive components.

CHEMICAL AVAILABILITY

Introduction, Reversible work, Availability, Irreversibility and Second-Law Efficiency for a closed System and Steady-State Control Volume.Availability Analysis of Simple Cycles.Chemical availability, Environmental state, Air-conditioning processes. Fuel Chemical availability, availability analysis of chemical processes – steam power plant, combustion and heat transfer losses, preheated

FUEL – AIR CYCLES AND THEIR ANALYSIS

Ideal gas laws and properties of Mixtures, Combustion Stoichiometry, Application of First Law of Thermodynamics – Heat of Reaction – Enthalpy of Formation – Adiabatic flame temperature. Second law of Thermodynamics applied to combustion – entropy, maximum work and efficiency.

THERMO CHEMISTRY

Chemical equilibrium: - Equilibrium combustion products. Dynamic properties of working fluids: - Unburned mixture – Low temperature combustion products – High temperature combustion products, problems.

References

1. Kenneth Wark., J. R, Advanced Thermodynamics For Engineers, McGraw-Hill Inc., 1995.
2. Yunus A. Cengel and Michael A . Boles, Thermodynamics, McGraw-Hill Inc., 2006.
3. B.P. Pundir, I.C. engine combustion and emissions.
4. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Sons, 1988.
5. Holman,J.P., Thermodynamics, Fourth Edition, McGraw-Hill Inc., 1988
6. Smith, J.M. and Van Ness., H.C., Introduction to Chemical Engineering Thermodynamics, Fourth Edition, McGraw-Hill Inc., 1987.

AUT18R5014	ARTIFICIALINTELLIGENCEAPPLICATIONS INAUTOMOTIVEENGINEERING	L	T	P	C
		3	0	0	3

INTRODUCTIONTOARTIFICIALINTELLIGENCE

Introduction to artificial intelligence – definition – A.I applications – A.I representation - properties ofinternalrepresentation -heuristicsearchtechniques-bestfirstsearch,meanandendanalysis- A*andAO*algorithm – gameplaying– minimizesearch procedure– alphabetacutoffs– waitingforquiescence– secondary search.

AIINMANUFACTURING

Design and manufacturing –AI integration through quality – intelligentsoftware system for intelligent manufacturing – architecture for integrating enterprise automation - application of AIin industries - utilizationand functionality - architecture of export system, knowledge representation, and two case studies on expert systems –knowledge based expert system – product andprocess design – relationsbetweenmanufacturingandAIresearchers.

AIINROBOTICS

Programmecontrolandsubroutines-communication anddataprocessing-monitor modecommands-representing andrecognizingscenes,waltzalgorithm,constraintdetermination -trihedral figures labeling knowledge representation usingpredicatelogic- predicatecalculus-predicateandarguments- ISAhierarchy-framerotation, resolution - natural deduction – symbolic representation and planning for robot controlsysteminmanufacturing.

KNOWLEDGEREPRESENTATIONUSINGNONMONOTONICLOGIC

TMS(truthmaintenancesystem),statisticalandprobabilisticreasoning- fuzzylogic, structureknowledgerepresentation- semanticnet- frames,script- conceptual dependency planning-blockworld,strips-implementation usinggoalstack-non linearplanningwithgoalstacks-hierarchicalplanning-listcommitmentstrategy.

NEURALNETWORKS

Introductiontoneuralnetworksandperception– qualitativeanalysisonly,neuralnetarchitectureandapplication-naturallanguageprocessingandunderstandingandpragmatic,syntactic,semantic,analysis,RTN,ATN, understandingsentences.

References

1. ElaineRichandKerinKnight,ArtificialIntelligence,McGrawHill,1990.
2. KishenMehrotra,SanjayRawika,K.Mohan,ElementsofArtificialNeuralNetwork,MITPress,1996.
3. A.Fazel, Famili, Dana S.NauandstevenH.Kim. Artificial IntelligenceApplicationinManufacturing.,AAAIPress,1992.
4. M. W. Firebaugh, Artificial Intelligence, Artificial knowledge based approach,BoydandFrasherPublishingCo,1988.
5. Charniac,EandM.C.Dermott,IntroductiontoAI,AddisonWesley,1986.

AUT18R5015	FINITEELEMENTANALYSISFOR AUTOMOTIVESYSTEMS	L	T	P	C
		3	0	0	3

FINITEELEMENTANALYSIS

Historicalbackground- weightedresidualmethods-basicconceptof fem-variationalformulationofB.V.P.-Ritzmethod-finite element modeling -element equations- linear and quadratic shape functions - bar, beam elements - applications to heat transfer.

FINITEELEMENTANALYSISOF2DPROBLEMS

Basicboundaryvalueproblemsin 2 dimensions-triangular,quadrilateral,higherorderelements-poissonsandlaplaceequation- weakformulation- elementmatricesandvectors-applicationtosolidmechanics,heattransfer,fluidmechanics.

ISO-PARAMETRICFORMULATION

Natural co-ordinate systems -lagrangianinterpolation polynomials -isoparametricelements – formulation - numerical integration - 1D, 2D, triangular elements - rectangularelements-illustrativeexamples.

SOLUTIONTOPLANEELASTICITYPROBLEMS

Introductiontotheoryof elasticity-planestress-planestrainandaxisymmetricformulationprinciplesofvirtualwork,consistentandlumpedformulation -useoflocal co-ordinates,elementmatricesusingenergyapproach.

SPECIALTOPICS

Dynamic analysis–equationofmotion-massmatrices-freevibrationanalysis-naturalfrequenciesoflongitudinal-transverseandtorsionalvibration-introduction totransientfieldproblem- nonlinearanalysis-useofsoftwares- handpelements-specialelementformulation.

References

1. M.AsgharBhatti,L.J.,FiniteElementAnalysis and Applications,JohnWiley,2005.
2. Rao,S.S.,Finiteelementmethodinengineering,Elseiver,2011.
3. ChandraguptaandBelagundu, Introduction toFiniteelementsinEngineering,Pearson, 2012.
4. Buchaman,G.R.,Schaum'soutlineoffiniteelementanalysis,McGraw-Hill Company,1995.

AUT18R5016	MODELINGANDSIMULATIONOF AUTOMOTIVESYSTEMS	L	T	P	C
		3	0	0	3

GENERALCONSIDERATIONSOFMODELING

Governing equations - conservation ofmass, conservationofenergy, conservation of momentum-numericalmethodology-computingmesh–Discretisation-gridformation.

SPRAYMODELING

Sprayequationmodels-thinspraymodels,thickspraymodels-dropletturbulenceinteractions,dropletimpingementonwalls-fullfieldmodel,K-ξModel,

IN-CYLINDERFLOWMODELING

Laminarflowmodeling-probabilitydensityfunctions- Ekmanlayersroll-upvortex, vortex structures - compression generated turbulence, effective viscosity, and turbulentdiffusivity.

INRODUCTIONTOCOMBUSTIONMODELING

Classification– zerodimensionalmodeling,quasi-dimensionalmodeling, multidimensional modeling -comparison ofdifferent combustion systems, combustionefficiency,applications,classification-multizonemodels-heattransfer Cp-relations - Weibe'sfunction analysis - white house-way model - two zone models-mathematicalmodelingofcatalyticconverters-onedimensionalmodel– 2Daxi-symmetricmodelofmonolithicreactor-computationofchemicalreactions.

ENGINESIMIUATION

Combustionindieselengines–heattransferinengines– heattransfercorrelations-simulationofOttocycleatfullthrottle,partthrottleandsupercharged conditions- progressive combustion -exhaustandintakeprocessanalysis-engineandportinggeometry-gasflow,scavenging.

References

1. TarekEchekki and Epaminondas Mastorakos,Turbulent Combustion Modeling,Springer,2011.
2. G. Stiesch,Modeling Engine spray and combustion processes,Springer,2003.
3. Joseph Colannino, Modeling of Combustion Systems, CRC press, 2006.

AUT18R5017	COMPUTATIONALFLUIDDYNAMICS	L	T	P	C
		3	0	0	3

GOVERNINGDIFFERENTIALEQUATIONAND FINITEDIFFERENCE METHOD

Classification - initial and boundary conditions - initial and boundary value problems - finite difference method - central, forward, backward difference - uniform and non -uniform grids - numerical errors - grid independence test.

CONDUCTIONHEATTRANSFER

Steady one - dimensional conduction, two and three dimensional steadystateproblems,transientonedimensionalproblem,two-dimensional transientproblems-steadyonedimensionaltransientproblems.

INCOMPRESSIBLEFLUIDFLOW

Governingequations,streamfunction–Vorticitymethod-determinationofpressure for viscous flow - Simple procedure of Patankarandspalding- computation of boundarylayerflow.

CONVECTIONHEATTRANSFER

Steadyone-dimensional andtwo-dimensional convection–diffusion,unsteadyone-dimensionalconvection–diffusion-introductiontofiniteelementmethod–solution ofsteadyheatconductionbyFEM–incompressibleflow–simulationbyFEM.

TURBULENCEMODELS

Algebraic Models– one equation model,K-ξ Models,standardandhighandlowReynolds number models -prediction of fluid flow and heat transfer using standardcodes.

References

1. Oleg Zikanov,Essential computational fluid dynamics, John Wiley and Sons.Inc, 2010.
2. Subas, V. Patankar, Numerical heat transfer fluid flow, Hemisphere Publishing Corporation,1980.
3. T.J.Chung, Computational Fluid Dynamics, second edition, Cambridge University Press, 2010.

AUT18R5018	FLOW VISUALISATION TECHNIQUES FOR I.C. ENGINES	L	T	P	C
		3	0	0	3

INSTRUMENTATION FOR FLOW VISUALISATION

Schilieren photography – Laser Velocimetry – Illuminated Particle Visualisation Holography – ParticleImageVelocimetry.

FLOW VISUALISATION OF INTAKE PROCESS

Engine optical access, Design of optical engine, Thermal properties of materials used for optical engine, processing of materials – Optical techniques.

IN-CYLINDER FLOW

Visual Experiment of In-cylinder flow by Laser sheet method.Intake flow visualization by light colour layer examination of principle and photographic measurement techniques.

COMBUSTION VISUALISATION

Endoscopes, Advanced cameras, Fiber Optic Tools, Laser diagnostics of Flames.

NUMERICAL FLOW VISUALISATION

Direct, Geometric and texture based flow visualization, Dense Geometric Flow visualization – Surface flow visualisation.

REFERENCES:

1. A.J.Smits and T.T.Lim, Flow Visualization Techniques and Examples, Imperial College Press, 2012.
2. J.P. Holman, Experimental Methods for Engineers, McGraw – Hill Inc., 2001.
3. Wolfgang Merzkirch, Flow Visualisation, 2nd Edition, Academic Press, 1987.

AUT18R5019	SIMULATION OF I.C. ENGINE COMBUSTION PROCESS	L	T	P	C
		3	0	0	3

SIMULATION PRINCIPLES

First and second laws of thermodynamics – Estimation of properties of gas mixtures - Structure of engine models – Open and closed cycle models - Cycle studies. Chemical Reactions, First law application to combustion, Heat of combustion – Adiabatic flame temperature. Hess Law-Lechatlier principle. Heat transfer in engines – Heat transfer models for engines. Simulation models for I.C. Engines. (Ideal and actual cycle simulation) Chemical Equilibrium and calculation of equilibrium composition.

SIMULATION OF COMBUSTION IN SI ENGINES

Combustion in SI engines, Flame propagation and velocity, Single zone models – Multi zone models – Mass burning rate, Turbulence models – One dimensional models – Chemical kinetics modeling – Multidimensional models, Flow chart preparation.

SIMULATION OF COMBUSTION IN CI ENGINES

Combustion in CI engines Single zone models – Premixed-Diffusive models – Wiebe' model – Whitehouse way model, Two zone models - Multizone models- Meguerdichian and Watson's model, Hiroyasu's model, Lyn's model – Introduction to Multidimensional and spray modeling, Flow chart preparation.

SIMULATION OF TWO STROKE ENGINES

Thermodynamics of the gas exchange process - Flows in engine manifolds – One dimensional and multidimensional models, Flow around valves and through ports Models for scavenging in two stroke engines – Isothermal and non-isothermal models, Heat Transfer and Friction.

SIMULATION OF GAS TURBINE COMBUSTORS

Gas Turbine Power plants – Flame stability, Combustion models for Steady Flow - Simulation – Emission models.Flow chart preparation.

References

1. Joseph Colannino, Modeling of Combustion Systems, CRC press, 2006.
2. V.Ganesan, Computer Simulation of Spark Ignition Engine Processes, Universities Press, 2000.
3. Cohen H. Rogers GEC. – Gas Turbine Theory – Pearson Education India Fifth edition, 2001.

AUT18R5020	INTERNAL COMBUSTION ENGINE DESIGN	L	T	P	C
		3	0	0	3

FUNDAMENTALS STUDIES FOR ENGINE DESIGN

Principle of similitude, Choice of material, mechanical properties of material and Noise, Vibration and Harshness considerations (NVH), Engine performance characteristics, Basics of ignition and fuel injections, cylinder arrangements, static and dynamic balance, bore stroke ratio calculation.

DESIGN OF FOREMOST ENGINE COMPONENTS

Design of piston, piston grown or bowl design, piston rings and pin, power cylinder system, cam shaft, connecting rod assembly, crankshaft, valve gearing mechanism, cylinder block, cylinder-headanalysis of stress fluctuations.

DESIGN OF ENGINE SUBSYSTEMS

Inlet and exhaust manifolds, crankcase, engine mountings, gaskets, bearings, flywheel, turbocharger, supercharger, computer controlled fuel injection system, lubrication and cooling system design. Design of mufflers.

DESIGN SPECIFICS OF TWO-STROKE ENGINE SYSTEMS

Arrangement and sizing of ports, engine and port geometry, piston assembly, intake and exhaust system, scavenging ratio and delivery ratio, experimentations in scavenging flow, design of combustion chamber, cylinder trap design.

CONCEPTS OF COMPUTER AIDED DESIGN

Preparation of physical geometry , strategic planning, part modelling procedure, meshing techniques, 1D, 2D and 3D meshing, element quality analysis, assigning materials property in model, Boundary conditions, linear and nonlinear analysis, post processing techniques.

References

1. Vehicular Engine Design, Kevin L. Hoag, SAE International USA
2. Design and simulation of two stroke engine, GordanP.Blair, Society of Automotive Engineers, Inc, 1996.
3. Springer – Verlag, Wien, Austria, 2006.
3. Engineering Design, A Systematic Approach, G. Pahl, W. Beltz J. Fieldhusen and K.H. Grote, Springer
4. Internal Combustion Engine Fundamentals, John B. Heywood, McGraw – Hill Book Company, 2012.
5. Internal Combustion Engine Design, A. Kolchin and V. Demidov, MIR Publishers, Moscow, 1984.
6. Design and Simulation of Four-Stroke Engines, Gordon P. Blair, Society of Automotive Engineers, Inc., USA, 1999.

AUT18R6001	VEHICLE DYNAMICS AND STRUCTURES	L	T	P	C
		3	0	0	3

FUNDAMENTALS OF VIBRATION

Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort.Modelling and simulation studies. Single degree of freedom, free, forced and damped vibrations. Magnificationfactorand transmissibility.Vibration absorber.Vibration measuring instruments.Two degree of freedom system, modal analysis.

HANDLING CHARACTERISTICS OF VEHICLES

Steering geometry.Steady state handling characteristics.Steady state response to steering input.Transient response characteristics.Directional stability of vehicle.

TYRES

Tire forces and moments, rolling resistance of tires, relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, ride properties of tyre.

PERFORMANCE CHARACTERISTICS OF VEHICLE

Equation of motion and maximum tractive effort.Aerodynamics forces and moments Power plant and transmission characteristics.Prediction of vehicle response to braking, crashworthiness of a vehicle.

DYNAMICS OF SUSPENSION SYSTEM

Requirements of suspension system.Spring mass frequency, wheel hop, Wheel wobble, wheel shimmy, choice of suspension spring rate.Calculation of effective spring rate.Vehicle suspension in fore and aft, Hydraulic dampers and choice of damping characteristics.Compensated suspension systems.Human response to vibration, vehicle ride model. Load distribution. Stability on a curved track, banked road and on a slope.

References

1. Groover, “Mechanical Vibration”, 7th Edition, Nem Chand &Bros, Roorkee, India, 2003.
2. W.Steeds, ‘Mechanics of road vehicle’ Illiffe Books Ltd, London 1992
3. JG.Giles, ‘Steering, Suspension tyres’, Illife Books Lid London 1975
4. P.M.Heldt, ‘Automotive chassis’, Chilton Co ., Newyork, 1982
5. J. R. Ellis, ‘Vehicle Dynamics’, Business Books, London, 1969.

AUT18R6002	HEAT TRANSFER EQUIPMENT DESIGN	L	T	P	C
		3	0	0	3

SHELL AND TUBE EXCHANGERS

Classificationofheattransferequipment-Designofshellandtubeheatexchanger-Finned surfaceheatexchanger-Heat exchangers forspecialservices- Firedheaters

PLATE HEAT EXCHANGERS

Plate and spiral plate heat exchanger - plate heat exchanger for Dairy industry - Heat Pipes – Application and Limitations

DESIGN OF HEAT EXCHANGERS

ThermaldesignofheatexchangeequipmentssuchasAirpre-heaters,Economizer-Superheater andcondensers.

COMPACT HEAT EXCHANGERS

Introduction to compact heat exchangers - Selection of compact heat exchangers – design of compact heat exchangers- application of compact heat exchangers-limitations compact heat exchangers

COOLING TOWERS

Introduction to cooling towers-classification of cooling tower-Analysis and design of cooling towers-application and limitation of cooling tower

References

1. Manfred Nitsche, R O Gbadamosi, Heat Exchanger Design Guide: A Practical Guide for Planning, Selecting and Designing of Shell and Tube Exchangers, Butterworth-Heinemann, 2015.
2. J.E. Hesselgreaves, Richard Law, David Reay, Compact Heat Exchangers: Selection, Design and Operation, Butterworth-Heinemann, Second edition, 2016.
3. D.A. Reay, P.A. Kew, R.J. Mc Glen, Heat Pipes: Theory, Design and Applications, Sixth Edition, 2014.
4. Kakac, S. and Liu, H., Heat Exchangers, CRC Press, 2002.
5. G. B. Hill, E. J. Pring, Peter D. Osborn, Cooling Towers: Principles and Practice, Butterworth-Heinemann, 2013.

AUT18R6003	ADVANCEDHEATTRANSFER	L	T	P	C
		3	0	0	3

CONDUCTIONANDRADIATIONHEATTRANSFER

One dimensionalenergyequationsandboundarycondition- threedimensionalheatconduction equations - conduction with heat generation - extended surface heat transfer-transientandperiodicheatconduction.

FREEANDFORCEDCONVECTIVEHEATTRANSFER

Dimensionalanalysis- boundarylayerconcept-basicgoverningequations- freeandforcedconvection-momentumandenergyequations- turbulentboundarylayerheattransfer-mixinglengthconcept-turbulencemodel-K-Emodel-analogybetween Heatandmomentumtransfer-Reynolds,Colburn,VonKarman,Turbulentflowinatube-highspeedflows.

PHASECHANGEHEATTRANSFERANDHEATEXCHANGER

Condensationwithshearedgeonbankoftubes,boiling–poolandflowboiling- heat exchanger-E-NTUapproachanddesignprocedure-compactheatexchangers.

RADIATION

Basiclawsofradiation- radiationinidealandrealsurfaces- viewfactoralgebra- radiation shields-electrical analogy using radiosityand irradiation -radiation in gaseousandvapours.

MASSTRANSFERANDENGINEHEATTRANSFERCORRELATION

Masstransfer- vaporizationofdroplets-combinedheatandmasstransferproblems-heattransfercorrelationsinI.C.engines.

References

1. Eckert, E. R. G. and Drake, R. M., AnalysisofHeatandMassTransfer, McGrawHillCo.,1980.
2. Ozisik,M.N.,HeatTransfer,Basicapproach,McGrawHillCo.,1985.
3. Bejan,A.,ConvectionHeatTransfer,JohnWileyandSons,1984.
4. Rohswnow, W. M., Harnett, J. P., and Ganic, E. N., Handbook of Heat TransferApplications,McGrawHill,NewYork1985.
5. Patankar. S.V., Numerical heat transfer and Fluid flow, Hemisphere PublishingCorporation,1980.
6. Carnahan,B.,Luther.H.A.,andWilkes,J.O.,AppliedNumericalMethods, WileyandSons,1976.

AUT18R6004	MECHATRONICS AND ROBOTICS	L	T	P	C
		3	0	0	3

INTRODUCTION TO MECHATRONICS

Introduction to Mechanical, Electrical, Fluid and Thermal Systems.Rotational and Transnational systems, electro-mechanical, hydraulic-mechanical systems.Basic principles, characteristics and selection issues for typical Sensors / Actuators used in mechatronics. Integration Electronics, Controls, Information technology with Mechanical system.

CONTROL SYSTEMS

Control Systems: Open loop, Close loop, Transfer function, Feedback and Feed-forward System. Response, modeling of dynamic system, Dynamic response of First, Second Order systems to Step, Ramp and Impulse inputs. Bode plot and stability of systems. Control actions, P, I, D.

COMPONENTS OF MECHATRONICS SYSTEMS

Stress, Strain and Force measurement using strain gauges. Study of devices as Accelorometers, tachometers, velocity measurement, potentiometers. Modeling of sensors, Modeling of Actuators, Steeper motors, D C / A C servos, Solenoids, Hydraulic and Pneumatic actuators, Piezo-electric sensors and actuators, Shape memory alloys.Signal conditioning, Operational amplifier, Protection, Filtering, Digital signal, Data acquisition using DAQ Board, Digital signal processing, A2D, D2A convectors.

DIGITAL LOGIC CIRCUITS

Number system, Combinational and Sequential circuits. Boolean algebra, binary / floating point arithmetic, Micro-processor building blocks, Terminology, Intel 8085, a microprocessor and a Micro-controller, Flow charts, Assembly language, Instruction set, sample programs, Structure of PLC, I/O Processing, Programming. Case studies: Data acquisition, Data acquisition and Control, MatLab Data acquisition application for controls

ROBOTICS AND AUTOMATION

Robot anatomy, Structure of Robots, Point to Point and Continuous path Robots, Robot Gripper, Sensors, Control systems, Sensors & Vision system in control, Actuators, modeling and control of a single joint, Kinematics, Transformation matrices, Link and Joint description, D-H parameters, Direct kinematics, Inverse kinematics, Velocities and static forces in manipulator.

Reference

1. Richard D. Klafter, Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach, Prentice Hall India, 2002.

2. Introduction to Mechatronics and Measurement Systems, David Alciators& Michael B. Histand, Tata McGraw Hills, India, 2001.

3. W. Stadler, Analytical Robotics and Mechatronics, McGraw Hill, 1994.

4. D. M. Auslander and C.J. Kempf, Mechatronics: Mechanical System Interfacing, Prentice Hall, 1995. 5. D.Shetty and R.Kolk, Mechatronic Systems Design,Wadsworth Publ., 1997.

AUT18R6005	AUTOMATICCONTROLENGINEERING	L	T	P	C
		3	0	0	3

BASICCONCEPTSANDSYSTEMREPRESENTATION

Terminology andbasicstructure-feedback control theory -multivariable systems - dynamic models - state variable models-impulse response models and transfer functionmodels-applicationtomechanical,thermal,hydraulic,pneumaticandelectromechanical systems - blockdiagramrepresentation andsignalflowgraphs- controlsystemcomponents.

TIMERESPONSEANALYSISANDDESIGN

Firstandsecondordersystems-performancespecifications-feedbackanalysis-P,PIand PID controllers design – effect of pole, zero addition-desired closed loop location-rootlocusplotandapplications-steadystateanddynamicerrorcoefficients- robustcontrol

FREQUENCYRESPONSEANALYSISANDDESIGN

Performancespecifications-correlation totimedomainspecifications-bodeplotsandpolarplots-gainandphasemargin-constantMandNcirclesandNicholschart– non-minimumphasesystems.

STABILITY

BIBOstability,Routh-Hurwitz criterion,stabilityrangesforaparameter -Nyquiststabilitycriterion-relativestabilityassessmentusingRouthandNyquistcriterionandbodeplots.

COMPENSATIONDESIGN

Design concepts-realisationof basic compensation-cascade compensation intimedomainandfrequencydomain,simpleMATLABapplicationstoanalysisandcompensatorsdesignproblems.

References

1. Ogatta,ModernControlEngineering,TataMcGrawHill,NewDelhi,1997.
2. NagarathI.J.andGopalM.,ControlSystemEngineering,WileyEasternLtd., Reprint,1995.
3. Dorf, R.C. and BishopR.H., Modern Control Systems, Addison Wesley, Boston,1995.

4.LeonardN.E.andWilliamLevine,UsingMATLABtoAnalysisandDesign ControlSystems,AddisonWesley,Boston,1995.

AUT18R6006	AUTOMOTIVEELECTRICALAND ELECTRONICS	L	T	P	C
		3	0	0	3

FUNDAMENTALSOFAUTOMOTIVEELECTRICALSYSTEMS

Battery - principle, construction and characteristics – battery rating capacity - efficiencyofbatteries-varioustestsonbatterycondition– electricpowersteering.

CHARGINGANDSTARTINGSYSTEMS

Chargingprinciples,circuits– generationofdirectcurrent,shuntgeneratorcharacteristics, voltage and current regulator, compensated voltage regulator - alternators, behaviourof starter during starting, working of different starter drive units,careandmaintenanceofstartermotor,newdevelopmentrequirementsofstarter system.

FUNDAMENTALSOFAUTOMOTIVEELECTRONICSYSTEMS

Electronicmanagementofchassissystem–vehiclemotioncontrol– automotive microprocessor uses – electronic dash board instruments – onboard diagnosis system– electroniccontrolofbrakingandtraction- automatictransmission,electronic clutch.

IGNITIONSYSTEMS

Typesof solidstateignitionsystemsandtheirprincipleofoperation,advantagesofelectronicignition systems,contactlesselectronicignitionsystem,distributorlessignition,electronicsparkstimingandcon trol,sparkarrester,throttlebodyinjection andmulti-portorpointfuelinjection.

SENSORSANDACTUATORS

Introduction, basicsensorsarrangement, typesofsensors –oxygensensors,crankangle position sensors – fuel metering and vehicle speed sensors and detonation sensors, altitude sensors, flow sensor, throttle position sensors, solenoids, stepper motors,relays, Microcontroller application in IC Engine.

References

1. Young, A. P.and Griffiths, L., AutomobileElectricalEquipment, EnglishLanguagesBookSocietyandNewPress,1990.
2. Vinal,G.W.,Storagebatteries,JohnWileyandSonsInc.NewYork,1985
3. Crouse,W.H.,AutomobileElectricalEquipment,McGrawHillBookCo.Inc. NewYork,1980.
4. SpreadBury,F.G.,ElectricalIgnitionEquipment, ConstableandCo.Ltd., London,1962.
5. Kholi,P.L.,Automotive Electrical Equipment, TataMcGraw-Hill CoLtd, NewDelhi,1975.

AUT18R6007	AUTOMOTIVE CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

VEHICLE PARAMETERS AND STATES

Vehicle velocity estimation, sensor data processing, Kalman filter approach, vehicle yaw rate calculation, fuzzy systems, calculations of wheel ground contact force, determination of road gradient, vehicle body slip angle observer.

ENGINE CONTROL SYSTEMS

Engine model for lambda control, adaptive control circuit, idle speed control, knock sensor control, cylinder balancing, stationary engine operation control, sensor signal processing, energy conversion and torque model, adaptations of injection map.

DRIVELINE CONTROL SYSTEMS

Basic driveline equation, control and modeling of neutral gear, controller formulation, driveline control with LQG/LTR, driveline speed control, RQV control, speed control with active damping, driveline control for gear shifting, transmission-torque control criterion, anti-jerking control for passenger cars.

ENGINE MANAGEMENT CONTROL

Effective work of engine, air-fuel ratio, inflammation of air-fuel mixture, flame propagation control unit and energy conversion, intermittent fuel injection, injection timing control module, ignition angle control.

DIAGNOSIS

Introduction to diagnosis, model based diagnosis, fault modelling, residual evaluation, air intake system diagnosis, misfire detection, crankshaft torque balance, and casestudies of model based diagnosis for SI engines.

References

1. UweKiencke, Lars Nielsen, Automotive control systems, 2nd Edition, springer, 2005.
2. A. GalipUlsoy, HueiPeng, MelihÇakmak,Automotive Control Systems, 2014
3. Wei Liu, Introduction to Hybrid Vehicle System Modeling and Control, 2017
4. “Automotive Engines: Control, Estimation, Statistical Detection” by Alexander A Stotsky, springer, 2009
5. “Advanced Topics in Control Systems Theory” by Julio Antonio Loría Perez and Françoise Lamnabhi-Lagarrigue, Springer, 2006

AUT18R6008	AUTOMOTIVE AIR CONDITIONING AND CLIMATE CONTROL	L	T	P	C
		3	0	0	3

FUNDAMENTALS

Terminology, design factors and concepts related to air conditioning system - Construction and Working principles of Thermostatic Expansion valve and Orifice tube based system - Heating system types -detailed study of HVAC components like compressor, evaporator, condenser, TXV, orifice tube , Receiver-drier, heater core etc. Location of air conditioning components in a vehicle.

REFRIGERANTS & AIR MANAGEMENT SYSTEMS

Refrigerants: Temperature and pressure relation, Properties of R-12 and R134a- refrigerant oil. Simple problems - Containers - Handling refrigerants - Tapping into the refrigerant container - Ozone Layer Depletion.Air management system: Air routing for manual, semi and automatic system- cases and ducts- Air distribution, control head and doors- Defrost system

AUTOMATIC CLIMATE CONTROL SYSTEM

Block diagram - types of Sensors and Actuators, - Control Logic Electrical wiring diagram of manual and automatic system - multiplexing between BCM and PCM- control of compressor clutch, blower motor etc.- diagnostics tools and features.

DESIGN OF AIR-CONDITIONING COMPONENTS

Modeling of Fixed and variable Displacement type compressor, evaporator modeling - heat transfer correlations for the fluids inside the evaporator, analysis of evaporator frosting-condenser modeling - improvement of refrigerant flow control method.

AIR CONDITIONING DIAGNOSIS AND SERVICES

AC system diagnosis based on temperature and pressure measurements, sight glass, sound etc. - refrigerant leak detection- Trouble shooting and Servicing of compressor, evaporator, condenser, heater core etc. – HVAC equipment , recovery and charging. Air routing system service.

REFERENCES

1) Goings. L.F., “Automotive air conditioning”, American Technical services, 1974
2) Paul Weiser, “Automotive air conditioning”, Reston Publishing Co Inc., 1990.
3) MacDonald, K.L., “Automotive air conditioning”, Theodore Audel series, 1978.
4) James D. Halderman, “Automotive Heating, Ventilation, and Air Conditioning Systems”, Pearson Education Inc., 2004.

AUT18R6009	TRIBOLOGY IN DESIGN	L	T	P	C
		3	0	0	3

BASIC PRINCIPLES OF TRIBOLOGY

Introduction to the concept of tribodesign, specific principles of tribodesign, tribological problems in machine design, Basic principles in tribology.Nature of engineering surface, surface topography, Measurement of surface topography.

CONTACT BETWEEN SURFACES

Contact between surfaces, Elastic and plastic deformation, surface and subsurface stresses, surface tension, surface energy, Friction theory, Junction growth, Friction due to plugging, adhesion, deformation, Friction under complex, motion conditions. Friction characteristics of metal and non-metals, rolling friction, Friction measurements.

TYPES OF WEAR AND THEIR MECHANISMS

Adhesive wear, Material selection for Adhesive wear situation, Abrasive wear, Materials for adhesive wear situation, wear due to surface fatigue, wear due to chemical reaction, wear measurements, wear of non-metals.

LUBRICATION THEORY

Composition and properties of oil and Grease lubricants, Gas lubricants, Viscosity measurements, ASTM standards Lubrication regimes, externally pressurized lubrication, Hydrodynamic lubrication, Elasto hydrodynamic, Boundary and solid lubrication. Performance analysis of thrust bearings and journal bearing.Selection and Design considerations, Design procedure Reynolds Equation with pressure and viscosity effects, Film thickness equation.

SURFACE ENGINEERING IN TRIBOLOGY

Introduction, Surface modifications, Thermo–Chemical processes, Surface coatings.

References

1. Gwidon W. Stachowiak, Andrew W Batchelor, “Engineering Tribology” Elsevier Science, 4th Edition, 2013.
2. PrasantaSahoo, “Engineering Tribology”, PHI Learning Pvt., Ltd., 2015.
3. AvrahamHarnoy, “Bearing Design in Machinery: Engineering Tribology and Lubrication”, CRC Press, 2002.
4. Ian Hutchings, Philip Shipway, ‘Tribology: Friction and Wear of Engineering Materials’, Butterworth-Heinemann, 2017.

AUT18R6010	METAL FORMING FOR AUTOMOTIVE INDUSTRIES	L	T	P	C
		3	0	0	3

SHEET METAL FORMING IN AUTOMOTIVE ENGINEERING

Forging - Open die forging, Impression/closed die forging, Stamping,Extrusion,Spinning, Shearing, Laser Cutting, Hot Forming, Superplastic forming,Stretch forming,Hydroforming,Electromagnetic Forming,

DRAWING

Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis ofwire, deep drawing and tube drawing.SheetMetal forming: Forming methods, Bending, stretch forming, spinning and Advancedtechniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts.

ADVANCED METAL FORMING PROCESSES

High Velocity Forming,Explosive forming,Electrohydraulic Forming, HERF, Electromagnetic forming, residual stresses,in-process heat treatment, computer applications in metal forming.Press tool design: Design of various press tools and dies like piercing dies, blanking dies,compound dies and progressive blanking dies, design of bending, forming and drawing dies.

METAL FORMING DEFECTS

Defects in forging process, Defects in sheet metal forming, defects in extrusion process, defects in advanced forming process, defects in drawing process – advantages and disadvantages.

TESTING FOR AUTOMOTIVE COMPONENTS

Simple Tensile Test, Tensile test with r- and n-value determination,Biaxial Tensile Test,Fracture Toughness Testing,Flexure Test,Draw Bead Test,High-Speed Tensile Test,Disk flexure test

References

1. George E. Dieter, “Mechanical Metallurgy”, McGraw-Hill Book Co., New York, 1986.
2. Z. Marciniak, J. L. Duncan, S. J. Hu, “Mechanics of Sheet Metal Forming”, Butterworth-Heinemann, 2002.
3. Sing C. Tang, Jwo Pan, “Mechanics Modeling Of Sheet Metal Forming”, Society Of Automotive Engineers Inc, 2007.
4. Edward Hoffman, “Jig and Fixture Design”, Cengage Learning US, 2004.

AUT18R6011	LEAN BURN ENGINES	L	T	P	C
		3	0	0	3

HCCI ENGINE FUNDAMENTALS

Introduction to HCCI, Controlled auto ignition (CAI), Basics of HCCI/CAI processes, Comparison of SI and CAI combustion, Methods to obtain CAI, CAI operation, Regimes of HCCI and Conventional Engine Operation

GASOLINE AND DIESEL HCCI COMBUSTION ENGINES

Conventional Gasoline Combustion, Effects of EGR, Techniques to HCCI operation in gasoline engines, Conventional Diesel Combustion, Overview of diesel HCCI engines, Techniques – Early Injection, Multiple injections, Narrow angle direct injection (NADI™) concept.

HCCI CONTROL

Control Methods, Combustion timing sensors, HCCI/SI switching, Transition between operating modes (HCCI-SI-HCCI), Fuel effects in HCCI - gasoline, diesel, auto-ignition requirement, combustion phasing, Influence of equivalence ratio, auto-ignition timing, combustion duration, auto-ignition temperature and auto-ignition pressure, Combustion limits, IMEP and indicated efficiency, other approaches to characterising fuel performance in HCCI engines.

HCCI FUEL REQUIREMENTS & COMBUSTION WITH ALTERNATIVE FUELS

Introduction, Background, Diesel fuel HCCI, HCCI fuel ignition quality, Gasoline HCCI, HCCI fuel Specification, Fundamental fuel factors. Natural gas HCCI engines, CNG HCCI engines, methane/n- butane/air mixtures. DME HCCI engine - chemical reaction model, Combustion completeness, Combustion control system, Method of combining DME and other fuels, 'unmixed-ness' of DME/air mixture

LOW-TEMPERATURE AND PREMIXED COMBUSTION

Basic concept, Characteristics of combustion and exhaust emissions, modulated kinetics (MK)combustion – First and Second generation of MK combustion, Emission, performance improvement.

REFERENCES:

1. Hua Zhao, 'HCCI and CAI Engines for automotive industry, Wood Head Publishing, 2007.
2. B.P.Pundir, 'I.C. Engines Combustion and Emission',Narosa Publishing House, 2017.
3. V.Ganesan, 'Internal Combustion Engines' McGraw Hill Book Co, 4th Edition, 2017.
4. J.B. Heywood, 'Internal Combustion Engine Fundamentals' McGraw Hill Book Co, 2017.

IV - INTERDISCIPLINARY ELECTIVES

(Offered to Other Disciplines)

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AUT18R5021	INTERNALCOMBUSTIONENGINEERING FUNDAMENTALS	L	T	P	C
		3	0	1	4

INTRODUCTIONTOICENGINES

Basicenginenomenclature–classification-cycles,comparisons- SIandCIengineoperations-stratifiedchargeenginecharacteristics, torque,IP,BPandefficiency- SFC-Air/fuelratio.

THERMODYNAMICSOFFUEL-AIRMIXTURES

Composition of air and fuels combustion stoichiometry - first law applied tocombustion -energy andenthalpy balances -enthalpies offormation -heating values-combustion efficiency ofICengine-secondlawappliedtocombustion- maximumworkandefficiency.

COMBUSTIONINSIANDCIENGINES

ThermodynamicanalysisofSIenginecombustion- flamestructureandspeed- cyclic variationsincombustion,partialburningandmisfire-abnormalcombustion-types ofdieselcombustionsystems-fuelspraybehavior- ignitiondelay- ignitionquality- auto ignition - factors affecting delay fuel properties – mixing, combustion (uncontrolledandcontrolled).

SUPERCHARGING

Objectives- effectsofengineperformance–requiredenginemodification-thermodynamicsofmechanicalsuperchargingandturbo- charging–turbo-charging methods-engineexhaustmodifications.

POLLUTANTFORMATIONANDCONTROL

Natureandextentofproblem-Nitrogenoxides-formationof NO_xinSIandCIengines - hydrocarbon emission from SI and CI engines - particulate emission - Exhaustgastreatment.

References

1. John, B. Heywood, Internal CombustionEngine, McGraw Hill Book Company,1988.
2. Ganesan,V.,InternalCombustionEngine,TataMcGrawHillBookCompany.
3. Edward,F.,Obert,InternalCombustionEngineandAirPollution,Harperand RowInternationalEdition,1973.

AUT18R5022	ADVANCED I.C ENGINES	L	T	P	C
		3	0	0	3

SPARK IGNITION ENGINE

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection – Spark plug-types - Stages of combustion – Normal and Abnormal combustion – Knock – Factors affecting knock – Combustion chambers.

COMPRESSION IGNITION ENGINE

Diesel Fuel Injection Systems – Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion – Introduction to Turbo charging and Super charging.

POLLUTANT FORMATION AND CONTROL

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction, Exhaust gas recirculation and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

ALTERNATIVE FUELS

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel – Properties, Suitability, Merits and Demerits – Engine Modifications.

RECENT TRENDS

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems – Hybrid Electric Vehicles – NOx Absorbers – Onboard Diagnostics.

REFERENCES:

1. Mathur. R.B. and R.P. Sharma, “Internal Combustion Engines”.,DhanpatRai& Sons 2007.
2. Duffy Smith, “Auto Fuel Systems”, The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, “Automobile Electronics”, SAE Publications, 1995.

AUT18R5023	FUELS AND COMBUSTION	L	T	P	C
		3	0	0	3

SOLID FUELS

Types of fuels-solid, liquid and gaseous fuels, family of coal, origin of coal, analysis and properties of coal, action of heat on coal, oxidation of coal, hydrogenation of coal, efficient use of solid fuels, manufactured fuels, agro fuels, solid fuel handling, properties related to combustion, handling and storage.

LIQUID AND GASEOUS FUELS

Origin and classification of Petroleum, refining and other conversion processes, composition of petroleum with respect to combustion, property and testing of petroleum products, various petroleum products, Nature of Indian Crudes & Petroleum refining in India, storage and handling of liquid fuels, liquid fuels combustion equipment. Types of gaseous fuels, Natural gases, methane from coal mine, Producer gas, water gas, blast furnace gas, LPG.

COMBUSTION AND EMISSION

Stoichiometry- Stoichiometry relations, theoretical air required for complete combustion, calculation of minimum amount of air required for known composition, calculation of dry flue gases if fuel composition is known, calculation of composition of fuel and excess air supplied from exhaust gas analysis, flue gas analysis (O_2, CO_2, NOx, SO_X)

FLAME AND BURNER DESIGN

Ignition and concept of ignition, auto ignition, temperature flame propagation, various methods of flame stabilization, Incorporation in burner design, basic features of solid, liquid and gaseous fuel burner, design consideration of different types of coal, oil and gas burners, recuperative and regenerative burners

ALTERNATE FUELS FOR IC ENGINES

Edible oils and non-edible oils for use in diesel engines, Gaseous fuels like hydrogen, CNG, LPG for use in petrol engine.

REFERENCE:

1. Sharma S P, Fuels and Combustion, Tata Me Graw Hills, New Delhi, 2000.
2. Roger A, Combustion Fundamentals, Me Graw Hills, New Delhi, 2000.
3. Shaha AK, Combustion Engineering & Fuel Technology, Oxford and IBH Publications, New York, 2003
4. Kenneth K Kou, Principles of Combustion, Wiley & Sons Publications, New York, 2002.
5. Mishra D.P, Fundamentals of Combustion, PHI Learning Pvt. Ltd, New Delhi, 2011.

AUT18R5024	MANUFACTURINGOFAUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

INTRODUCTIONTOAUTOMOTIVECOMPONENTS

Cylinderblocks- productionmethods,dryandwetliners,cylinderheads–types- productionmethods-productionofoilpan- piston–types–functionsmanufacturingmethods-productionofactuators-useofrobotsinassemblyline.

VALVESANDACCESSORIES

Valves-types–mechanisms-productionmethods-productionofpushrod,rockerarmandtappets–camshafts-manufacturingmethods–productionofcarburetors– kingpinsandpropellersshafts.

TRANSMISSIONSYSTEMS

Clutch-universaljoint–differentials-mainaxle-stubaxle-wheels.

BRAKES,SUSPENSIONANDENGINEMANAGEMENTSYSTEMS

Precisionandmicromachining-diamondturningofpartstonanometeraccuracy–stereomicrolithographymachiningofmicrosizedcomponents.

SURFACETREATMENTANDFABRICATION

Thermalspraying- vapourdeposition-ionimplantation- diffusioncoating– electroforming –anodizing - conversion coating-hotdipping-ceramiccoating– diamondcoating-explosiveweldinganddiffusionbonding.

References

1. KirpalSingh, Automobile engineering, Vol. I &II, Standard publisher's distributors,NewDelhi,1997.
2. Newtonandsteels,Themotorvehicle,ELBS,1980.
3. Narang,G.B.S.,Automobileengineering,Khannapublishers,1990.
4. Seropekalpakjian,ManufacturingEngineeringandTechnology,ThirdEdition- Addison-WesleypublicationCo.,1995.
5. Brahem,T.Smith,AdvancedmachiningI.F.S.,U.K,1989.
6. Amstead,B.H.,OstwaldPhilipsandBageman,R.L.,ManufacturingProcess JohnWiley'sSons,1987.
7. Muccic,E.A.,Plasticprocessingtechnology,Materialspark,Ohio,ASMint.,1994.
8. Jarger, R . C., IntroductiontomicroelectronicFabrication, Addison-Wesley,1988.

AUT18R5025	WELDINGTECHNOLOGY	L	T	P	C
		3	0	0	3

INTRODUCTION

Classification – heat sources – metallurgical effect of weld. Residual stresses: formation and relieving – capillary and welding action – temperature range – filler material and fluxes – types of joints and welding positions – Weldability: design, process and metallurgical consideration – testing and improvement.

WELDING PROCESSES

Fusion welding: Oxyacetylene welding – SMAW – GTAW – GMAW – FCAW – SAW – ESW. High energy beam welding: EBW, LBW, PAW – friction stir welding. Output parameter variation – advantages and disadvantages – applications.

DESTRUCTIVE TESTS FOR WELDS

Introduction – need – principles – applications – destructive tests: tensile, bend, impact, hardness, fatigue, cracking, etching.

NON-DESTRUCTIVE TESTS

Visual, dye penetrants, magnetic particle, acoustics, pressure, radiographic, ultrasonic, eddy current testing

RESPONSES OF MATERIALS TO WELDING

Microstructural changes – distortion – defects: undercuts – overlaps – grain growth – blowholes – inclusions – segregation – lamellar tearing – porosity.

References

1. "Welding handbooks", American Welding Society, 9th Edition.
2. O. P. Khanna, "Text book of welding technology", DhanpatRai& Sons, 2015
3. Howard B. Carry, Scott Helzer, "Modern welding technology", Prentice Hall, 2005.

AUT18R5026	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

BASCI ELECTRONICSYSTEMS

Electronicmanagementofchassissystem–vehiclemotioncontrol– automotive microprocessor uses – electronic dash board instruments – onboard diagnosis system– electroniccontrolofbrakingandtraction-automatictransmission,electronic clutch.

IGNITIONSYSTEMS

Typesof solidstateignitionsystemsandtheirprincipleofoperation,advantagesofelectronicignitionsystems,contactlesselectronicignitionsystem, non-distributor ignition,electronicsparkstimingandcontrol,sparkarrester,throttlebodyinjection andmulti-portorpointfuelinjection.

ELECTRONIC CONTROL SYSTEMS

Engine model for lambda control, adaptive control circuit, idle speed control, knock sensor control, cylinder balancing, stationary engine operation control, sensor signal processing, energy conversion and torque model, adaptations of injection map.

DRIVELINE CONTROL SYSTEMS

Basic driveline equation, control and modeling of neutral gear, controller formulation, driveline control with LQG/LTR, driveline speed control, RQV control, speed control with active damping, driveline control for gear shifting, transmission-torque control criterion, anti-jerking control for passenger cars.

SENSORSANDACTUATORS

Introduction, basicsensorsarrangement, typesofsensors –oxygensensors,crankangle position sensors – fuel metering and vehicle speed sensors and detonation sensors, altitude sensors, flow sensor, throttle position sensors, solenoids, stepper motors,relays, Microcontroller application in IC Engine.

References

1. SpreadBury,F.G.,ElectricalIgnitionEquipment, ConstableandCo.Ltd., London,1962.
2. UweKiencke, Lars Nielsen, Automotive control systems, 2nd Edition, springer, 2005.
3. A. GalipUlsoy, HueiPeng, MelihÇakmak,Automotive Control Systems, 2014
4. Wei Liu, Introduction to Hybrid Vehicle System Modeling and Control, 2017
5. “Automotive Engines: Control, Estimation, Statistical Detection” by Alexander A Stotsky, springer, 2009
6. “Advanced Topics in Control Systems Theory” by Julio Antonio Loría Perez and Françoise Lamnabhi-Lagarrigue, Springer, 2006.

V - GENERAL ELECTIVES

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EEE18R5020	SOFT COMPUTING TECHNIQUES	L	T	P	C
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INTRODUCTION AND FEEDFORWARD NEURAL NETWORK

Introduction to soft computing -soft computing vs hard computing-various types of soft computing techniques-applications of soft computing-Neuron-Nerve structure and synapse- Artificial Neuron and its model-activation functions-Neural network architecture-single layer and multilayer feed forward networks-McCullochPitts neuron model-perceptron model -Adaline and Madaline-multilayer perception model-back propagation learning algorithm- Implement back propagation learning algorithm using Matlab Toolbox.

RECURRENT NEURAL NETWORKS

Counter propagation network-architecture-functioning & characteristics of counter-Propagation network-Hopfield/ Recurrent network-configuration-stability constraints-associative memory- and characteristics-limitations and applications-Hopfield v/s Boltzman machine-Adaptive Resonance Theory-Architecture-classifications-Implementation and training-Associative Memory- Design of multilayer feed forward network using MATLAB Toolbox.

FUZZY LOGIC SYSTEM

Introduction to crisp sets and fuzzy sets-basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-Fuzzification-inferencing and defuzzification- Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control-Fuzzy logic control for nonlinear time delay system- Development of Neuro fuzzy system using MATLAB tool box.

GENETIC ALGORITHM

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm-Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems- Implementation of optimization problem using MATLAB Toolbox.

APPLICATIONS

GA application to power system optimization problem-Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural Network interconnection systems-Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox-Stability analysis of fuzzy control systems.

Text Book(s):

1. S.N. Sivanandam, S.N.Deepa, “Principles of Soft Computing” 2nd Edition, Wiley, 2011.
2. Fakhreddine O. Karray and Clarence De Silva, “Soft Computing & Intelligent System: Theory, Tools and Applications”, First edition, Pearson Education, 2009.

Reference(s):

1. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education. 2004
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India., 2010.

EEE18R6013	EVOLUTIONARY COMPUTATION TECHNIQUES	L	T	P	C
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EVOLUTIONARY COMPUTATION (EC): THE BACKGROUND

Outline of Evolutionary Algorithms (EA) – EA Terminologies – Robust adaptation and Machine Intelligence – Principles of Evolutionary Processes – Principles of Genetics – No-free Lunch theorem for EA – Advantages of EA over other approaches.

GENETIC ALGORITHM (GA)

Binary GA – genetic operators – Tournament, Proportionate and Ranking Selection – Single point, two-point and uniform crossover – Elitism – Real Parameter GA – Linear, naïve, blend and Simulated Binary Crossover – Random, Non-uniform, Normally distributed and Polynomial Mutation – Constraint Handling Techniques in GA.

EVOLUTIONARY STRATEGIES (ES) & EVOLUTIONARY PROGRAMMING (EP)

Non-Re combinative ES – Re combinative ES – Self Adaptive ES – Connection between RGA and Self adaptive ES – Evolutionary Programming(EP) – EP and ES: Similarities and Differences – Genetic Programming (GP) – Population size and Dynamics – Convergence and Stopping Criteria – Exploration and Exploitation.

Unit 4: PARTICLE SWARM OPTIMIZATION (PSO)

Concepts and formulation – Simulating the Social behavior – PSO algorithm – Topology – Parameter Selection and Improvements for Convergence – Maximum Velocity – Acceleration Constants - Constriction factor - Inertia weight – Advantages of PSO.

ANT COLONY OPTIMIZATION (ACO)

Ants' ForagingBehavior – Stigmergy – Double Bridge Experiment – Real Ants to Artificial Ants – Behavioral Differences – Properties of Artificial Ants – ACO Algorithms – Ant System - MAX−MIN Ant System – Ant Colony System (ACS) – Advances of ACO.

Text Book(s):

1. S.N. Sivanandam, S.N.Deepa, "Principles of Soft Computing" 2nd Edition, Wiley, 2011.
2. Fakhreddine O. Karray and Clarence De Silva, "Soft Computing & Intelligent System: Theory, Tools and Applications", First edition, Pearson Education, 2009.

Reference(s):

1. Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", 3rd Edition, John Wiley & Sons, 2008.
2. Thomas Back, David BFogel and ZbigniewMichalewicz, "Evolutionary Computation 1 &2 : Basic/advanced Algorithms and Operators", Institute of Physics Publishing, 2000.
3. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", MIT Press, 2004.
4. JurgenBranke, Kalyanmoy Deb, KaisaMiettinen and Roman Slowinski (Eds.), "MultiObjective Optimization: Interactive and Evolutionary Approaches", Springer-Verlag, 2008.

EEE18R5021	OPTIMIZATIONTECHNIQUES	L	T	P	C
		3	0	0	3

INTRODUCTION

Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints.

LINEAR PROGRAMMING (LP)

Simplex method of solving LPP, revised simplex method, duality, constrainedoptimization,Theorems and procedure, Linear programming, mathematical model, solution technique, duality.

NON LINEARPROGRAMMING

Steepest descent method, conjugates gradient method, NewtonsMethod, Sequential quadratic programming, Penalty function method, augmented Lagrange multiplier method.,

DYNAMIC PROGRAMMING (DP)

Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm

GENETIC ALGORITHM

Introduction to genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between Gas and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA, Applications to power system.

Reference(s):

1. Computational methods in Optimization, Polak, Academic Press, 1971.
2. Optimization Theory with applications, Pierre D.A.,WileyPublications, 1969.
3. Taha, H. A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi ,2002.
4. S.S.Rao,"Optimization–TheoryandApplications",Wiley-Eastern Limited, 1984.
5. G.Luenberger," Introduction of Linear and Non-Linear Programming",Wesley Publishing Company, 2011

CSE18R5051	CLOUD COMPUTING	L	T	P	C
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Unit-1

Introduction Cloud Computing: Nutshell of cloud computing, Enabling Technology, Historical development, Vision, feature Characteristics and components of Cloud Computing. Challenges, Risks and Approaches of Migration into Cloud.Ethical Issue in Cloud Computing, Evaluating the Cloud's Business Impact and economics, Future of the cloud. Networking Support for Cloud Computing. Ubiquitous Cloud and the Internet of Things

Unit-2

Cloud Computing Architecture: Cloud Reference Model, Layer and Types of Clouds, Services models, Data center Design and interconnection Network, Architectural design of Compute and Storage Clouds. Cloud Programming and Software: Fractures of cloud programming, Parallel and distributed programming paradigms-MapReduce, Hadoop , High level Language for Cloud. Programming of Google App engine,

Unit-3

Virtualization Technology: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor VMware, KVM, Xen. Virtualization: of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of data-center

Unit-4

Securing the Cloud: Cloud Information security fundamentals, Cloud security services, Design principles, Policy Implementation, Cloud Computing Security Challenges, CloudComputing Security Architecture. Legal issues in cloud Computing.
Data Security in Cloud: Business Continuity and Disaster Recovery , Risk Mitigation , Understanding and Identification of Threats in Cloud, SLA-Service Level Agreements, Trust Management

Unit-5

Cloud Platforms in Industry: Amazon web services Google AppEngine, Microsoft Azure Design, Aneka Cloud Application Platform -Integration of Private and Public Clouds Cloud applications: Protein structure prediction, Data Analysis, Satellite Image Processing, CRM and E ,Social networking . Cloud Application- Scientific Application, Business Application. Advance Topic in Cloud Computing: Federated Cloud/InterCloud, Third Party Cloud Services.

Text/Reference Books :

1. "Distributed and Cloud Computing " By Kai Hawang , GeofreyC.Fox, Jack Dongarra Pub: Elservier
2. Cloud Computing ,Principal and Paradigms, Edited By RajkumarBuyya, Jemes Broberg, Goscinski, Pub.- Wiley
3. Kumar Saurabh, "Cloud Computing" , Wiley Pub
4. Krutz , Vines, "Cloud Security " , Wiley Pub
5. Velte, "Cloud Computing- A Practical Approach" ,TMH Pub

CSE18R5052	IOT AND APPLICATIONS	L	T	P	C
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Unit 1

IoT& Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Unit 2

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit 3

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views

Unit 4

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Unit 5

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1 st Edition, VPT, 2014

2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1 st Edition, Apress Publications, 2013

3. CunoPfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493-9357-1

CSE18R5053	BIG DATA ANALYTICS	L	T	P	C
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INTRODUCTION TO DATA ANALYTICS

Data analytics process – roles, stages in data science project – working with data from files – working - with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL.

MODELING METHODS

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

INTRODUCTION TO R

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution.

MAP REDUCE

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing HadoopMapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

DELIVERING RESULTS

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph - using graphics parameters. Case studies.

References:

1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
2. Jure Leskovec, AnandRajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
3. 3. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
4. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.
5. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, AbhijitDasgupta, “Practical Data Science Cookbook”, Packt Publishing Ltd., 2014.
6. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, Wiley, 2011.
7. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
8. http://www.johndcook.com/R_language_for_programmerttp://bigdatauni