KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION

Curriculum and Syllabus

of

M.Tech – Automotive System Engineering

(Regulation 2018)

(CBCS)

DEPARTMENT OF AUTOMOBILE ENGINEERING

Sl.No.	Course Type	Credits Proposed	Credits
1	Core Theory Course	15	15
2	Lab Courses	6-8	8
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**	**73**

SCHEME OF INSTRUCTION

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	Automotive Materials and Metallurgy	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
3	AUT18R5083	Combustion and Emission Analysis laboratory	L	0	0	3	2
						Total	**8**

3. Supportive courses

Sl.No.	Course Code	Course Name	Course Type	L	T	P	C
1	MAT18RXXXX	Applied Mathematics	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	Course Type	L	P	T	C
1	AUT18R5006	Supercharging and Scavenging	T	3	0	0	3
2	AUT18R5007	Alternative Fuels for IC Engines	T	3	0	0	3
3	AUT18R5008	Combustion and Emission in Engines	T	3	0	0	3
4	AUT18R5009	Engine Pollution and Control	T	3	0	0	3
5	AUT18R5010	Engine Auxiliary Systems	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	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	T	3	0	0	3
14	AUT18R5019	Simulation of I.C. Engine Combustion Process	T	3	0	0	3
15	AUT18R5020	Internal Combustion Engine Design	T	3	0	0	3
16	AUT18R6001	Vehicle Dynamics and Structure	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	T	3	0	0	3

		and Climate Control					
24	AUT18R6009	Tribology in Design	T	3	0	0	3
25	AUT18R6010	Metal Forming for Automotive industries	T	3	0	0	3
26	AUT18R6011	Lean Burn Engines	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	AUT18R6097	Mini Project	L	0	2	0	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	10	0	10
2	AUT18R6099	Project Work Phase II		0	16	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	0	0	0	0
2	XXXXXXXXXX	Audit Course I	AC	0	0	0	0
						Total	**0**

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

Code	Name of the Subject	L	T	P	C
AUT18R5021	Internal Combustion Engineering Fundamentals	3	0	0	3
AUT18R5022	Advanced I.C Engines	3	0	0	3
AUT18R5023	Fuels and Combustion	3	0	0	3
AUT18R5024	Manufacturing of Automotive Components	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 of The Subject	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 of The Subject	L	T	P	C
1	XXXXXXXX	English for Research Paper Writing	3	0	0	0
2	XXXXXXXX	Disaster Management	3	0	0	0
3	XXXXXXXX	Sanskrit for Technical Knowledge	3	0	0	0
4	XXXXXXXX	Value Education	3	0	0	0
5	XXXXXXXX	Constitution of India	3	0	0	0
6	XXXXXXXX	Pedagogy Studies	3	0	0	0
7	XXXXXXXX	Stress Management by Yoga	3	0	0	0
8	XXXXXXXX	Personality development through Life Enlightenment Skill	3	0	0	0

MAT18R5002	Statistics andComputational Techniques	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Describethe basicconcept of probabilityand distributions

CO2: Understand the correlation and regression analysis

CO3: Explain the principle of estimation theory

CO4: Understandingtheterm Samplingdistribution, largesampletests

CO5: Describethe design of experiments

pROBABILITYDISTRIBUTIONS

Probability basicconcepts-Binomial,Poisson,Geometric,Normal,Uniform, Exponential,Gamma and Weibull- distributions- Mean,Variance,Momentgenerating functions.

CORRELATION ANDREGRESSION ANALYSIS:
Bivariatecorrelation–correlationinmultivariatesystems;Bivariatelinearregression–statisticaloptimization–principleofleastsquares–reliabilityoftheregressionequation – reliabilityofpointestimatesofregressioncoefficients– confidenceintervalofthe regression equation –correlation versus regression - Multiple Regression Analysis: Matrixsolutionofthestandardizedmodel-criteria forevaluatingamultipleregression model – Analysisofresiduals

ESTIMATION THEORY
Estimationofparameters-Principlesofleastsquares-Maximumlikelihoodestimation- Method of moments-Interval estimation

TESTINGOFHYpOTHESIS
Samplingdistribution,Largesampletests-MeanandProportion,Smallsampletests-t- test ,F-test and Chi-Squaretest.-Goodness of fit-Independenceof attributes.

DESIGN OFEXpERIMENTS
Design of Experiments:Basic Designs, FactorialDesign,ANOVA

Text Book(s):

1. Jay,L.Devore,ProbabilityandStatisticsforEngineeringandSciences,Brooks Cole PublishingCompany,Monterey, California,1982.
2. Gupta,S.C.andKapoor,V.K,FundamentalsofMathematicalStatistics,Sultan Chand and Sons, New Delhi, 11th Edition.
3. PaulMacBerthouexandLinfieldC.Brown, "Statistics forEnvironmental Engineers",Second Edition,Lewis Publishers, Washington D.C. , 2002

References:

1. Trivedi,K.S.,ProbabilityandStatisticswithReliability,Queuing andComputer ScienceApplications,PHI.
2. Kapur, J.N. and Saxena, H.C,Mathematical Statistics, S.Chandand Co.Ltd., 18th Revised Edition, 1997.
3. Douglas C. Montgomery,Designand analysisof experiments,John Wileyand sons, 7th edition, 2010.

AUT18R5001	VEHICLE ENGINE TECHNOLOGY	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Differentiateamongdifferent internal combustion engine designs

CO2: Givenanenginedesignspecification,predictperformanceandfueleconomy trends with goodaccuracy

CO3: Developanability tooptimizefutureenginedesignsforspecificsetsofconstraints (fueleconomy, performance, emissions)

CO4: Learntocompareandcontrastexperimentalresultswiththeoreticaltrends,andto attributeobserved discrepancies to either measurement error or modelinglimitations

CO5: Throughtheuseofboththeoreticaltechniquesandexperimentation,developan appreciation for theoretical and practical limits toengineperformance andfuel economy

ENGINE BASIC THEORY

Engineconstructionandtheiroperation–Classification–OperatingcyclesofS.I.and C.I.enginesEngineSubsystems:Ignitionsystem–ConventionalandElectronic,Cooling systems –radiator types and Lubricating systems Performance Testing of engines: Volumetricefficiency -FrictionPowermeasurement-Performancecurvesfor SIandCI engines -Heatbalance –Performancemaps.

FUELSUppLYSYSTEMS–SI ENGINES

Mixturerequirements–Theoryofcarburetion–SimpleCarburetor-ModernCarburetor –Carburetor types–Drawbacks of carburetor. Petrol injectionsystems –Types – ComponentsofFuelInjectionsystems–ElectronicEngineControl–InjectionStrategies –Airflowmetering–Operationalmodes–WorkingprincipleofTBI,D-Jetronic,L- Jetronic, K-Jetronic, KE-Jetronicsystems and GasolineDirectInjection(GDI) systems

FUELSUppLYSYSTEMS–CI ENGINES

Functionalrequirements–Components–InjectorNozzlecontrol–Injectiontypes:Unit, UnitPumpandCommonRail systems–InjectionPumps–Injectors:Pintle,Pintauxand Orifice types–Electro Hydraulic Injectors: Solenoid and Piezo actuated. Advance InjectionSystems:CommonRailDirectInjection(CRDI)systems– HEUIsystems– Cummins HPITPsystems–Xtreme PressureInjection (XPI) systems

COMBUSTION IN ENGINES

TypesofcombustionCombustioninSIengines:PhasesofSparkIgnition–Stagesof Combustion–Flamedevelopment–FlameStructure–FlamePropagation–Abnormal Combustion –Factors affecting knocking Combustion in CI engines: Stages of combustion–Factorsaffectingignitiondelay–SprayCharacteristics:Cavitation,Spray penetration,SprayAtomization,Spray EvaporationandDropletDistribution–Abnormal Combustion

AIRINDUCTION SYSTEMSAND COMBUSTION CHAMBERS

ChargeMotion:IntakeJetFlow–Turbulence–Swirl–SwirlGeneration–Squish ChargingSystems:SuperchargersandTurboChargers–Typesandworking-Boost control-Chargecooling.CombustionChambers:Requirements–Designconsiderations –SwirlratioandSurfacetoVolumeratio–SIenginecombustionchambers–CIEngine combustion chambers –Open andIDItypes

practicalComponent

1. Analyzethe heat transfercharacteristics ofdifferent radiatorfluid.
2. Conduct and draw theheat balancingdiagram fordiesel engine
3. Performance and Emission characteristics ofSplit injected CI Engine.
4. Effect of injection pressureon Diesel Engine Performance.
5. Analyzetheperformanceandemissionparametersofdieselengineatdifferent fuel injection timings.

ReferenceBooks

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. KlausMollenhauerandHelmutTschoeke,'Handbook ofDieselEngines'Springer, 2010.
4. Robert Bosch,'AutomotiveHandBook',SAE, 8th Edition, 2007.
5. HeinzHeizler, 'AdvancedEngine Technology'.Butterworth Heinemann, 1998.
6. John.B.Heywood,'InternalCombustionEngineFundamentals'McGrawHillBook Co, 2017.

AUT18R5002	AUTOMOTIVEMATERIALS AND METALLURGY	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Understand theyieldingbehaviorand dislocation influenceon plasticdeformation
CO2: Understandthevarious strengthening mechanismsand high temperature deformation
CO3: Definedifferent forms ofprocessingtechniques ofsurfaceengineeringmaterials
CO4: Selection ofmaterials forSpecificengineeringapplications and processes.
CO5: Identifythephasespresentindifferentmaterialandalloysystemsby analyzing the phasediagrams

ELASTICANDpLASTICBEHAVIOUROFMATERIALS
Elasticforms -stress andstrainrelationship in engineering materials-ironcarbondiagram -deformation mechanism- plastic stressstrainrelations-sliplinefieldtheory–dislocation theory-strengtheningmechanisms- strain hardening,alloying, polyphasemixture,martensiticprecipitation,dispersionhardening,fiberand texture strengthening-preferredorientation.

FAILUREOFMATERIALS
Fracture,classificationandtypes, Griffith'stheory-notcheffects,stressconcentration-conceptof fracture toughness-metallographic aspectsof fracture- fractography, ductile brittletransition–fatigue-mechanismofcrackinitiation andgrowth-fatigueunder combinedstresses,factorsaffectingfatigue– creep-creepcurve,creepmechanism, metallurgical variables ofcreep-super plasticity.

CHARACTERISTICSOFMATERIALS
Castability, machinability, formabilityand weldingofengineeringmaterials such as steel,castiron,alloy steels,brass,bronzeandaluminumalloy-behaviorofmaterialsfor hightemperature–wearandcorrosionresistanceapplication-residualstressanalysisby diffraction methods -metallurgical characterization ofautomotivematerials.

SELECTIONOFMATERIALS
Criteria of selectingmaterialsforautomotivecomponentsvizcylinderblock,cylinder head,piston,pistonring,gudgeonpin,connectingrod,crankshaft,crankcase,cam, cam shaft, enginevalve,gearwheel, clutchplate, axle,bearings,chassis,spring,radiator, brake liningetc-applicationofnon-metallic materialssuchas composite,ceramicandpolymers in automobilecomponents.

HEATTREATMENTANDSURFACETREATMENT
Heattreatmentofsteel-annealing,normalizing,hardeningandtemperingwithspecific relevancetoautomotivecomponents,surface hardening techniques,inductionandflame hardening-coating forwearandcorrosionresistance,electroplating,electrolessplating, phospating,anodizing, thermal spraying, hardfacingand thinfilmcoatings.

practicalComponents
1. Surfaceroughness measurement ofmetals.
2. Heattreatment studies on ferrousand non-ferrousmetals.
3. Failuremodeeffectiveanalyseonautomotivestructural components.
4. Thermographystudies onheat treated alloys.

5. Metallurgicalcasestudiesoncorrosion,wearandhightemperatureinautomotive applications.

References

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

AUT18R5003	MANUFACTURINGAND TESTINGOF AUTOMOTIVE COMPONENTS	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Knowthefundamental concepts ofmetal casting, meltingtechniques and its limitations

CO2: Knowtheconceptsofvariousmetalformingtechniquesanditsapplicationsand limitations regardingthemanufactureof various wrought products

CO3: Know thepowder metallurgy concepts of powder production, sintering and nanomaterial processing techniques

CO4: Describethevarioussample/specimenpreparationtechniquesforXRD,SEM, TEM and thermal analysis and quantitative metallography

CO5: Understandtheprocessofinspection,samplingandtheirstatisticalapproachin qualitymanagement in industry

INTRODUCTION TO MANUFACTURINGTECHNIQUES

Casting, typesof casting process, forging process, forming operations, machining techniques,heattreatment,surfacehardening,CNC,highenergyrateformingprocess andothersecondary operations.Precisionandmicromachining-diamondturningofpartstonanometeraccuracy–stereomicrolithographymachining of microsized components.

MANUFACTURINGOFENGINE COMpONENTS

Manufacturingofconnectingrod,crankshaft,camshaft,engineblock,cylinderhead, piston,pistonringsandpin,carburetors,inletandexhaustvalve,productionofpushrod, rockerarm and tappets, injector assembly, casestudy.

MANUFACTURINGOFTRANSMISSION ANDAXILLARY SYSTEMS

Clutch, flywheel, Gear train, universal joint, differential, main axle, stub axle, wheels,brakes, suspensionsystems,leafspring,coilspring,propellershaft,casestudy.

TESTINGINSTRUMENTAL TECHNIQUES

FTIRspectrometer,Thermalanalyzer,X-rayanalyzer,Opticalemissionspectroscopy, GasandLiquidChromatography,Highstrainrate tester,Non- destructive instruments, Newinnovationsintestingandcharacterization,X-ray Diffraction,Electronmicroscope (SEM,TEM),Scanningprobemicroscopy (SPM,AFM),Spectroscopicmethods(EDS, FTIR); Mechanical behaviors, Thermal response, Chemical resistanceand Electrical- Magnetic-Optical properties.

QUALITYANDTESTING

Introduction toISO9000, ISO14000, QS9000, its importance, BIS codes fortesting varioustypes ofengines,equipment required,instrumentation andcomputeraidedengine testing, metrologyfor manufacturing I.C. engine components.

practicalComponents

1. Tensile andhardness testing of automotive components according to ASTM standards.
2. Residualstressmeasurementinautomotivecomponentswiththehelpof XRD

method.

3. Chemical and mechanical characterization of newer materials used for automotive applications.
4. Fatigue analysison leaf spring, connectingrod,valves and other components.
5. Wear studies on automotive components with an aid of pin-on-disc apparatus.

Reference

1. SeropeKalpakjian,'Manufacturing EngineeringandTechnology', Pearson; 7th Edition,2013.
2. Yang Leng, 'Material Characterization: Introduction to Microscopic &Spectroscopic Methods, JohnWileyPvtLtd, 2013.
3. Rajan.T.V.'HeatTreatmentPrinciplesandTechniques', Prentice-HallofIndia Pvt.Ltd.,2nd Edition, 2010.
4. ASM Handbookon Metals Handbook: Volume: 8Mechanical Testing and Evaluation, 1978.

AUT18R5081	COMPUTERAIDED VEHICLEDESIGN LABORATORY	L	T	p	C
		0	0	3	2

CourseOutcomes:

CO1: Gain workingknowledgein Computer Aided Design methods and procedures

CO2:Solve simple structural, heat andfluid flow problems usingstandardsoftware

CO3: Interpret theresults obtained from the analysis

CO4: Calculation oftheload conditions in the components and the

CO5: Comparethe results obtainedfrom the manual designand computer design

- Design of piston,piston pin and piston rings anddrawingof thesecomponents.
- Designingofconnectingrod,smallendandbigendshankdesign,designofbig end crank arms, anddrawingofthe connectingrod assembly.
- Designofcrankshaft,balancingweightcalculations,developmentofshortand longcrank arms, front endandrear end details, drawing crankshaftassembly.
- Designanddrawingofflywheel,ringgeardesign,drawingoftheflywheel includingofring gearteeth.
- Designand drawingof inletandexhaustvalves.
- Designand drawingof Cam and Cam Shaft.
- DesignofCombustion Chamber.
- DesignanddrawingofEngineCompleteassemblyinvolvedwithcylinder block,cylinderhead,crankcase,valveports,water jackets,frontandrearend details.
- Completedesign ofclutch components. Componentsand assemblydrawing.
- Geartraincalculations,LayoutofGearbox.Calculationofbearingloadsand selection ofbearings. Complete assemblydrawing usingdrafting software.

AUT17R5004	AUTOMOTIVECHASSIS AND BODYENGINEERING	L	T	p	C
		3	**0**	1	4

CourseOutcomes:
CO1: Understand andhave knowledge about different aspects related to bodyand chassis.
CO2: Design the chassis and able to select thematerials of same.
CO3: Designthecabinandframecomponenttotransfertheforceandoptimizefrom aerodynamicand pointof view.
CO4: To study importance and features of different systems like suspension and balancingetc
CO5: Tostudyimportanceandfeaturesofdifferentsystemslikeaxle,differentialand brakes

CHASSISSTRUCTURALDESIGN
Chassisstructuraldesign,various typesofframes,superstructure,constructional details, materials,properties, weight reduction, structural efficiency loading, torsional, bending,stiffness,loadinputpoints,static/dynamic loads–crashworthiness,roller protection,driver protection.

VEHICLEBODYENGINEERING
Body details –car, bus, commercial vehicles – selection and properties of body materials,trim and mechanisms.

VEHICLEAERODYNAMICS
Generationof aerodynamicloads onvehicles –roadloadsduetoaerodynamicforces– aerodynamic design of vehicles– load transfer due to cornering– rollover stability– vehicledrag andvariousbodyoptimizationtechniquesforminimumdrag–typesof forces,moments and effects– windtunnel testing,scaling, measuring techniques– component balance to measureforces andmoments.

SUSpENSIONSYSTEM
Types and applications–material for spring- stress–deflection equation for helical spring, Wahlcorrectionfactor–designof helicalsprings–tensionsprings–bucklingof spring– springsin paralleland inseries–analysisofsuspensionsystem:Kinematic analysis– compliances,non-lineareffects–effect ofspringanddampersonsteadystate and transientand ling–forces inmembers.

AUTOMOTIVEBRAKES
Overviewofbrakesystem- designconsiderationinbrakes–band- internalexpanding shoe-externalcontracting,longandshort-energy equation -thermalconsiderationand ratingof brakes.

practicalComponent
1. Tension and impact teston mild steel rod
2. Doubleshear test on Mild steel rods
3. Torsion test on mild steel rod
4. Dismantlingand assemblyof steeringsystem
5. Dismantlingand assemblyofDifferential.

References

1. Kirpalsingh,automobileengineeringvol-1,standardpublishersdistributors,India ,2017
2. AndrewLivesey, AlanJ.A.Robinson,TheRepairofVehicleBodies,routledge, 2013
3. Pouloski,J,VehicleBodyEngineering,BusinessBooksLtd.,1989.
4. Hocho,E.H.(Ed),Aerodynamicsofroadvehicles,SAE,(4thEdition),1998
5. Adams,H.,ChassisEngineering,H.P.Berks,1993.
6. Gillespie,T.D.,Fundamentalsofvehicledynamics,SAE,1992.

AUT18R5005	AUTOMOTIVE TRANSMISSIONSYSTEM	L	T	p	C
		3	0	1	4

CourseOutcomes:
CO1: Relate theconventional clutch and gear mechanism with advanced recent technologies likefluid couplingand automatictransmission system
CO2: Summaries the basic ofthe axles, propellerand differentials with their accessories
CO3: Distinguish different kinds of drive like hydrostatic, hydrodynamicand electrical.
CO4: Categoriesdifferentkindsofautomatictransmissionsystemandrelateall their advantagesand disadvantages
CO5: CompareandContrastvariousautomatictransmissionsystemusedbyvarious manufacturers.

CLUTCHESANDGEARBOX
Designrequirementsoffrictionclutches-selectioncriteria-torquetransmissioncapacity -single plateclutch-multipleplateclutch-lining material-fluidcoupling-design considerationofgearbox- selectionof propergearratioforanautomobilegearbox-designofshafts-splinesandgears,designofgearandshaftforgearbox-differenttypes ofgear boxes-performancecharacteristics.

AXLES,pROpELLORSHAFTS,FINAL DRIVEAND DIFFERENTIAL
Designoffrontandrearaxlesforautomobiles-rearaxleshousing-designofpropeller shafts forbendingtorsion and rigidity, universaljoints and slip joints-differenttypesof drives-wormandwormwheel- bevelandhypoidgearfinaldrives–doublereductionand twinspeedfinaldrives- differentialprinciples- constructiondetailsof differentialunits- non slip differential-differential locks-differentialhousings.

HYDROSTATICDRIVESANDELECTRICALDRIVES
Hydrostaticdrives-varioustypesofhydrostaticsystems-principlesofhydrostatic drive systems-advantagesandlimitations-comparisonofhydrostatic with hydrodynamic drives-constructionandworkingof typicalhydrostaticdrives-electricaldrives- principles anddesign-advantagesand limitations-performancecharacteristics.

AUTOMATICTRANSMISSON
Semi-automatic transmissionfor cars and heavy vehicles- layout and operation-automatic transmission -advantages,basic constructionandoperation-automatic transmissionfor passenger cars-hydraulic operation-continuousvariabletransmission-operatingprinciple- basiclayout and operation-advantagesandlimitations.

AUTOMATICTRANSMISSIONAppLICATIONS
Chevrolet "Turboglide" transmission. Toyota's Automatictransmissionwith Electronic controlsystem.ContinuouslyVariableTransmission(CVT)–types–Operations.

practicalComponents
1. Determinethegearratioof the SlidingMesh/Synchromesh Gear Box.
2. Dismantlingand assemblyof single plate clutch
3. Dismantlingand assemblyof Multiplate clutch
4. Dismantlingand assemblyof SlidingMesh GearBox.
5. Dismantlingand assemblyof synchromesh GearBox.

References

1. Heinz Heisler, 'Advanced Vehicle Technology',2nd edition, Butterworth – Heinemann,2002.
2. N. K.Giri,'AutomobileMechanics',7th Edition,KhannaPublishers, 2008.
3. K. Newton, W.Steeds, T.K.Garret, 'The Motor Vehicle',13th Edition, Butterworth Heinemann,2004.
4. Grouse. W. H, 'AutomotiveChassis andBody', McGraw Hill,1971.

pGM18R5001	RESEARCHMETHODOLOGY	L	T	p	C
		1	0	0	1

CourseOutcomes:
CO1: Describethe objective and types of research
CO2: Understand themethods of problem solving
CO3: Explain the relation between tables andgraph
CO4: Understand theroleof computer onresearch and optimization technics
CO5: Understand thestructureof report andcomponents

INTRODUCTION
DefinitionandobjectivesofResearch–Typesofresearch,VariousStepsinResearch process,Mathematicaltoolsfor analysis, Developing aresearchquestion-Choice ofa problemLiteraturereview, Surveying,synthesizing,criticalanalysis,reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research –APA Ethicscode.

QUANTITATIVE METHODS FOR pROBLEMSOLVING
Statistical modeling and analysis, time series analysis probability distributions, Fundamentalsof statisticalanalysisandinterference,multivariate methods,conceptsof correlation and regression, fundamentalsoftime series,analysisand spectralanalysis, erroranalysis, applications of spectralanalysis.

DATA ANALYSIS
Tablesandgraphsoffrequencydataofonevariable,Tablesandgraphsthatshowthe relationshipbetweentwovariables,relationbetweenfrequencydistributionsandother graphs, preparingdatafor analysis.

SOFT COMpUTINGAppLICATION
ComputeranditsroleinresearchUseofstatisticalsoftwareSPSS,GRETLetcin research.Introductiontoevolutionary algorithms-fundamentalsofgeneticalgorithms, simulated annealing,and neuralnetwork basedoptimization, optimizationof fuzzy systems.

REpORTWRITING
StructureandComponentsofResearchReport,TypesofReport,LayoutofResearch Report, Mechanismof writingaresearch report, referencingin academicwriting

TEXT BOOKS
1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, VishwaPrakashan, 2006
2. DonaldH.McBurney,ResearchMethods,5thEdition,ThomsonLearning,ISBN:81-315-0047-0,2006

REFERENCE BOOKS
1. Donald R.Cooper, Pamela S.Schindler, Business Research Methods, 8/e, Tata McGrawHillCo.Ltd. 2006.
2. Fuzzy Logic with EnggApplications, TimothyJ.Ross, WileyPublications, 2nd Ed[d].
3.SimulatedAnnealing:TheoryandApplications(Mathematicaanditsapplications,by P.J.VanLaarhoven&E.H.Aarts[e]

4. Genetic Algorithms in search, optimization and machine learning by David E Goldberg

AUT17R5082	AUTOMOTIVEANDAUTOTRONICS LABORATORY	L	T	p	C
		0	0	3	2

CourseOutcomes:
CO1: Understand theperformance and emission characteristics ofIC engine.
CO2: Describethe properties of automobilefuels
CO3: Explain the workingofautomobile electronics

AutomobileLaboratory:
- Performanceteston a4 strokeengine.
- Viscositydetermination ofagivenfluid.
- Moment ofinertia forconnecting rod.
- Determination of effectiveness ofaparalleland counterflowheatexchangers.
- Valvetimingof4stroke and port timingof 2 strokeengine.
- Performanceteston 2stroke engine.
- Measurement ofHC,C0, $C0_2$,0_2usingexhaust gasanalyzer.
- Dieselsmokemeasurements.

AutotronicsLaboratory:
- Studyofrectifier and filters.
- Characteristics ofamplifiers.
- Studyoflogicgates, address andflip-flops.
- StudyofSCRandIC timer.
- DIAand AIDconverter.
- Assemblylanguageprogramming exercise.
- InterfacingAID converter and simpledataacquisition.
- Interfacingsteppermotorcontrol and CRT terminal.
- Microcontrollerprogrammingand interfacing

programElectives

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AUT18R5006	SUPERCHARGINGAND SCAVENGING	L	T	p	C
		3	0	0	3

CourseOutcomes:
C01: Understand the basic ofsupercharging method
C02: Differentiatevarious types of superchargers
C03:Interpret thefunctions of scavengingpumpsin two stroke engines
C04: Analyzethe designparameter ofports andmufflerdesign
C05: Design anew innovativemethod for scavengingprocess andexperiment thesame.

SUpERCHARGING
0bjectives- effects on engine performance- engine modification required- thermodynamics ofsupercharging and turbocharging- turbocharging methods-engine exhaust manifolds arrangements-Limitations ofsupercharging.

SUpERCHARGERS
Types ofcompressors –positive displacements blowers-centrifugal compressors – performance characteristic curves - suitability for engine application –surging – matchingof compressors, turbineengine.

SCAVENGINGOFTWOSTROKEENGINES
Peculiarities of twostrokecycleengines- classificationof scavengingsystems –mixture controlthroughreedvalveinduction-chargingprocessintwostrokecycleengine – terminologies–Shankey diagram -relationbetweenscavenging terms - scavenging modeling–perfect displacement, perfect mixing-complexscavenging models.

pORTSANDMUFFLERDESIGN
Porting-designconsiderations-design ofintake and exhaustsystems-tuning.

EXpERIMENTALMETHODS
Experimentaltechniquesforevaluating scavenging-firingenginetests-nonfiringengine tests-portflowcharacteristics-Kadenacysystem-orbitalenginecombustionsystem-sonicsystem.

References
1. John. B. Heywood, 'Two-Stroke Cycle Engine:It's Development, 0perationandDesign',CRCPress,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',MacmillanCo.,1984.

AUT18R5007	ALTERNATIVEFUELSFORIC ENGINES	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Understand thepotential benefitsof alternatefuels and theircharacteristics

CO2: Use appropriatesynthetic fuels and fuel additives for better combustion characteristics of SIEngine

CO3: Use appropriatesynthetic fuels and fuel additives for better combustion characteristics of CIEngine

CO4: Utilize differentgaseous fuels and predict theirperformanceand combustion characteristics for SIEngine

CO5: Utilize differentgaseous fuels and predict theirperformanceand combustion characteristics for CIEngine

INTRODUCTION

Availability,Suitability,Properties,MeritsandDemeritsofPotentialAlternativeFuels– Ethanol,Methanol,Diethylether,Dimethylether,Hydrogen,LiquefiedPetroleumGas, Natural Gas,Bio-gas andBio-diesel.

LIQUID FUELSFORS.I. ENGINES

Requirements,Utilisationtechniques–Blends,Neatform,ReformedFuels,Storageand Safety, PerformanceandEmission Characteristics

LIQUID FUELSFORC.I. ENGINES

Requirements,Utilisationtechniques-Blends,Neatfuels,Reformedfuels,Emulsions, Dual fuelling, Ignition accelerators and Additives, Performance and emission characteristics.

GASEOUSFUELSFOR S.I. ENGINES

Hydrogen,CompressedNaturalgas,LiquefiedPetroleumgas,andBiogasinSIengines –SafetyPrecautions–Engine performanceand emissions.

GASEOUSFUELSFOR C.I. ENGINES

Hydrogen, Biogas,LiquefiedPetroleumgas,CompressedNaturalgasinCIengines. Dual fuelling,-Performance andemission characteristics.

References

1. VinayKumar,'Performance andModellingofICEnginefuelledwithBiodiesel– Potential ofAutomotive Fuel',Lambert AcademicPublishing, 2016.
2. Thipse.S.S, 'Alternativefuels',JaicoBook Distributors, 2010.
3. Osamu Hirao,RichardKPefley,'PresentandFutureAutomotiveFuels',John Wiley, 1988.
4. Keith Owen, Trevor Eoley,'Automotive Fuels Handbook', SAEPublications,1990.

AUT18R5008	COMBUSTION AND EMISSIONIN ENGINES	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Given anengine design specification, predict performanceand fuel economy trends
CO2: Applybasic concepts inthe design of combustion systems in SIengines
CO3: Applybasic concepts in the design of combustion systems in CIengines
CO4: Developanunderstandingofrealworldgasturbineenginecombustionissuesand process
CO5: Developanabilitytooptimizefutureenginedesignforbetterfueleconomy, performanceand emissions

COMBUSTION pRINCIpLES
Combustion – Combustionequations, heat of combustion - Theoretical flame temperature –chemical equilibrium and Dissociation -Theories of Combustion - Flammability Limits-Reactionrates-LaminarandTurbulentFlame Propagationin Engines.

COMBUSTIONIN S.I.ENGINES
Stagesofcombustion,normalandabnormalcombustion,knocking,Variablesaffecting Knock,Featuresand designconsideration of combustionchambers.Flamestructureand speed,cyclic variations,Leanburn combustion, Stratifiedcharge combustionsystems. Heatreleasecorrelations.

COMBUSTION IN C.I. ENGINES
Stagesofcombustion,vaporizationoffueldropletsandsprayformation,airmotion, swirlmeasurement,knockandengine variables,Featuresanddesignconsiderationsof combustionchambers,delay periodcorrelations,heatreleasecorrelations,Influenceof the injection system on combustion, Direct and indirect injection systems.

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

EMISSIONS
Carbonmonoxide,UnburntHydrocarbons,OxidesofNitrogen,Particulatematterand smoke–sources.EmissioncontrolmeasuresforSIandCIengines.Effectofemissions on environment and human beings.

References
1. B.P.Pundir, 'I.C. Engines Combustionand Emission',NarosaPublishing House, 2017.
2. Ramalingam,K.K,'Internal CombustionEngines', SciTechPublicationsPvtLtd., 2016.
3. V.Ganesan, 'Internal Combustion Engines'McGraw Hill Book Co, 4th Edition, 2017.
4. John.B.Heywood,'InternalCombustionEngineFundamentals'McGrawHillBook Co, 2017.
5. Mathur.M.L.Sharma,R.P,'ACourseinInternalCombustionEngines',DhanpatRai Publications, 2014.

AUT18R5009	ENGINEPOLLUTIONAND CONTROL	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Toprovideaninsightabouteffectofengineoutemissionsonhumanhealthand environment
CO2: ToimparttheknowledgeonvariouspollutantspeciesformationsinSIandCI engine
CO3: Todivulgeaboutvariousemissionmeasurementtechniquesinenginesandits significance
CO4: To provide adiscernment about various emission control methods
CO5: Toimparttheknowledgeaboutinternationalandnationaldrivingcyclesand emission standards

AIRpOLLUTION-ENGINESAND TURBINES
AtmosphericpollutionfromAutomotiveandStationaryenginesandgasturbines,Global warming–Green-houseeffect,effectsofenginepollutiononenvironment,effectsof enginepollution to human

pOLLUTANTFORMATION
Formationofoxidesofnitrogen,carbonmonoxide,hydrocarbon,aldehydesandSmoke, Particulate emission. Effects ofEngine Design - operating variables on Emission formation -Design Variables on Emission Formation–Noisepollution.

EMISSION MEASUREMENT TECHNIQUES
Nondispersiveinfraredgasanalyser,gaschromatography,chemiluminescentanalyser andflameionizationdetector,smokemeters,GasAnalyzer–Noisemeasurementand control.

EMISSION CONTROL TECHNIQUES
EngineDesignmodifications,fuelmodification,evaporativeemissioncontrol,EGR,air injection,thermalreactors, WaterInjection,catalytic converters,applicationof microprocessorinemissioncontrol.Commonrailinjectionsystem,Particulatetraps, NOxconverters, SCR systems. GDIand HCCIconcepts.

DRIVINGCYCLESAND EMISSION STANDARDS
Transientdynamometer,Testcells,Drivingcyclesforemissionmeasurement,chassis dynamometer, CVS system, National andInternational emission standards.

References
1. B.P.Pundir,'Engine Emissions:FundamentalsandAdvancesinControl', 2nd Edition, Narosapublishing, 2017.
2. John.B.Heywood,'InternalCombustionenginefundamentals',McGraw–Hill, 2017.
3. CrouseWilliam,'AutomotiveEmission Control',McGraw-Hill,1980.
4. Ernest S, Starkman, 'Combustion Generated Air Pollutions', Plenum Press, 1980.
5. GeorgeSSpringer,DonaldJ.Patterson,'Engineemissions:PollutantFormationand Measurement', Plenum press, 1973.
6. Obert,E.F,'Internal CombustionEnginesandAirPollution', Harper &Row Publishers, 3rdEdition,1973.

AUT18R5010	ENGINE AUXILIARYSYSTEMS	L	T	p	C
		3	0	0	3

CourseOutcomes:

C01: Understand theBasics of carburetion and carburetor
C02: Describetheworkingprincipleofgasolineand fuel injection system
C03: Analyzethe Dieselfuel injection systemand their combustion characteristics
C04:Interpret thedesignof manifolds and engineefficiency
C05:Understandthelubricationandcoolingsystembasicsandtheirapplicationin automobiles

CARBURETION

Gasoline-airmixtures.Mixturerequirements-Mixtureformation-Carburettor,Choke, Carburettorsystems for emission control-SecondaryAirInjection.

GASOLINE INJECTION AND IGNITION SYSTEMS

PetrolInjection-PneumaticandElectronicFuelInjectionSystems,Ignitionsystems-Requirements,TimingSystems,Energy requirement,Sparkplugoperation,Electronic& Distributor lessIgnition Systems.

DIESEL FUELINJECTION SYSTEMS

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

INTAKE AND EXHAUST MANIFOLDS

Intakesystemcomponents,Airfilter,Intakemanifold,VGT,VNT,Exhaustmanifold andexhaust pipe, Exhaust mufflers &Resonators.

LUBRICATION ANDCOOLINGSYSTEMS

Lubricating systems- Theory, requirements and types, Lubrication - piston rings, crankshaftbearings,camshaft,Coolingsystems–Need,Engineheattransfer,liquidand air cooled engines, 0il cooling, Additives and lubricityimprovers.

References

1. V.Ganesan, 'Internal Combustion Engines' McGraw Hill Book Co, 4th Edition, 2017.
2. Eric Chowanietz, 'Automobile Electronics', SAEInternational, 1995.
3. HeinzHeisler,'Advanced EngineTechnology', ButterworthReinmannPublishers, 2nd Edition, 2002.
4. DuffySmith,'Auto FuelSystems', GoodReartWilcoxCompanyInc,Publishers, 1987.

AUT18R5011	AUTOMOTIVESYSTEMS SAFETY, QUALITYANDRELIABILITY	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Abilityto summarizebasics ofindustrial safety

CO2: To identifyandanalysesvarious safetytechnologies incorporated inautomobiles **CO3:** Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO4: Recognizethevarioussafety technologiesincorporatedinautomobilesand their pros and cons

CO5: Interpret thekeyconcepts of reliabilityandqualityusageinautomotiveindustry

SAFETYMANAGEMENTpRACTICESINAUTOMOTIVEINDUSTRIESNeedforsafety-safetyconcepts–safetymanagementfunctions–safetycommittee- safety auditandsurvey- safety inspection–safety sampling–jobsafety analysis–damage control-disastercontrol–emergencypreparednessplan-accidenttypes–causesandcost ofaccidents-housekeeping–safetyeducationandtraining-accidentreporting-accident investigation–accident preventionprograms–first aid-firefighting-personalprotective equipments.

SAFETYSYSTEMANALYSIS

Introduction–definitions-safety systems- safetycontrol systems- organizations and managementofsafety- safety information system,basicconcepts,informationsources, coding sources,documentation,processing ofinformation-safety budgetallocation-cost benefit analysis-allocatingthebudget-total losscontrol–benefits.

HAZARDSANDRISKSINAUTOMOTIVEINDUSTRIES

Introduction –hazard -risk–safety analysis –risk assessment -Techniques and methodologiesforriskanalysis–checklist-whatifanalysis-RazardandOperability Studies(RAZOP)-FaultTree Analysis(FTA)- EvenTree Analysis(ETA)-FailureMode Effect Analysis (FMEA) –Material SafetyDataSheet(MSDS) -computer aidedhazardanalysis–expert systemand artificialintelligenceapplication-faultdetectionand diagnosis.

TRANSpORTSAFETY

introduction-factorsforimprovingsafetyonroads-causesof accidentsduetodrivers andpedestrians – safetyindesign,selection,operationandmaintenanceoftransport vehicles - preventive maintenance –servicing -check list -insurance –Transport emergency card (TREM)- warning symbols- responsibility of driver- transport precaution-safedriving-historyoflegislationsrelatedtosafety-safetyprovisionsinthe factoryact-indianmotorvehiclesactandrules-workmencompensationact-ESI act- OSRAstandards.

RELIABILITYANDQUALITY

Reliability–reliability function–MTBF- MTTF-mortality curve-availability–maintainability- failure data analysis – repair time distributions - graphical evaluation-reliability rediction-failurerateestimates-effectofenvironmentandstress-seriesandparallel systems–RDBanalysis–standby systems-complexsystems-total quality management–QCTools–qualitycircles–qualityfunctiondeployment–5S– Kaizen–Sixsigma– qualitymanagement system–ISO–implementation steps.

References

1. AccidentPreventionManualforlndustrialOperations,NSC,Chicago,1982.
2. Babkov.V.F,'Roadconditionsandtrafficsafety',MlRPublications, Moscow,1986.
3. Dhillon.B.S, Singh.C, 'Engineering Reliability- New Techniques and Applications',JohnWiley,1981.
4. ErnestJ.Renley, RiromitsuKumamoto, 'Designingforreliabilityandsafetycontrol',PrenticeRall,1985.

AUT18R5012	VEHICLEMAINTENANCE	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Abilityto describefundamentals of maintenanceengineering
CO2: Describefundamentals of maintenance engineeringapplicablefor engines
CO3: Identifypreventive and periodicmaintenance chassis driveline components
CO4: Understand thepreventive and periodicmaintenanceof electrical System
CO5: Interpret theimportanceof thepreventiveand periodicmaintenanceof cooling and lubrication system

MAINTENANCERECORDSANDSCHEDULE
Importanceofmaintenance-scheduledandunscheduledmaintenance-preparationof checklist-chassislubrication-costeffectiveness-pre-trip,inspectionform-logbooks, trip sheets-othermaintenancerecordform.

MAINTENANCEOFENGINE
Dismantling of engine components- cleaning methods- visual inspection and dimensionalcheckofvariousenginecomponents- minorandmajortuneup, reconditioning,repairingmethodsofenginecomponents-assembly procedure-special tools used formaintenance, repairand overhauling.

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

MAINTENANCEOFELECTRICALSYSTEMS
Battery-testingmethods-startermotor-chargingsystem-dcgenerator,acalternator, ignitionsystem- coilignition, transistorassistedignition, capacitordischarge ignition-electric horn,wiper,flasher,electricfuelpumps,gauges,lightingsystem,headlight focusing,wiringsystem.

MAINTENANCEOFCOOLINGSYSTEM, LUBRICATION SYSTEM,FUELSYSTEMANDBODY
Coolingsystem-types,waterpumps,radiator,thermostatvalve-anticorrosionandanti-freezingsolutions-lubricating system-oilanalysis,oiltoppingup,oilchange,oilfilters, oilrelief valve- fuelsystem- petrol, dieselfuelfeedsystemcomponents- body repair tools,minorbody panelbeating,tinkering,soldering,polishing,painting-doorlocks mechanism-windowglassactuating mechanism.

References
1. JohnDoke,Fleetmanagement,Mc-GrawRillCo,1984.
2. Maleev,V.L.,Dieselengine operation and maintenance, Mc-GrawRill Book Co,NewYork,1984.
3. Leslie FGoing, Automotive maintenance and trouble shooting, American TechnicalSociety,1972.

AUT18R5013	THERMODYNAMICSFOR IC ENGINEERING	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: To demonstrate the useof correlations forthe important properties
CO2: To achieve an understandingof realgas equations and multicomponent systems.
CO3: Topredicttheavailabilityandirreversibilityassociatedwiththethermodynamic processesand Chemicalavailabilityofreactivesystems.
CO4: To introducephase equilibrium concept forpuresubstance and mixtures.
CO5: To applythe first and second lawof thermodynamics to reactivesystems.

THERMODYNAMICpROpERTYRELATIONS
Thermodynamic Potentials, Maxwell relations, Generalisedrelations for changes in Entropy,InternalEnergy andEnthalpy,GeneralisedRelationsforCpandCv, ClausiusClayperonEquation, Joule-Thomson Coefficient,BridgemanTablesfor ThermodynamicRelations.

REAL GAS BEHAVIOURANDMULTI-COMpONENTSYSTEMS
EquationsofState(mentionthreeequations),Fugacity,Compressibility,Principleof CorrespondingStates,Useofgeneralisedchartsforenthalpy andentropy departure, fugacity coefficient, Lee-Keslergeneralisedthree parameter tables. Fundamental property relationsforsystemsofvariablecomposition,partialmolarproperties,Realgas mixtures,Idealsolutionof realgasesandliquids,Equilibriuminmulti-phase systems, Gibbs phaserulefor non-reactivecomponents.

CHEMICAL AVAILABILITY
Introduction,Reversiblework,Availability,IrreversibilityandSecond-LawEfficiency foraclosedSystemandSteady-StateControlVolume.Availability AnalysisofSimple Cycles.Chemicalavailability,Environmentalstate,Air-conditioning processes.Fuel Chemicalavailability,availabilityanalysisofchemicalprocesses–steampowerplant, combustion and heat transfer losses, preheated

FUEL–AIRCYCLESAND THEIR ANALYSIS
Idealgas laws and properties of Mixtures,Combustion Stoichiometry, Applicationof FirstLawofThermodynamics–ReatofReaction–EnthalpyofFormation–Adiabatic flametemperature.SecondlawofThermodynamicsappliedtocombustion– entropy, maximum work and efficiency.

THERMO CHEMISTRY
Chemical equilibrium: - Equilibrium combustion products. Dynamic propertiesof workingfluids:-Unburnedmixture–Lowtemperaturecombustionproducts–Righ temperature combustion products, problems.

References
1. KennethWark.,J.R,AdvancedThermodynamicsForEngineers,McGraw-Rill Inc., 1995.
2. YunusA.CengelandMichaelA.Boles,Thermodynamics,McGraw-RillInc., 2006.
3. B.P. Pundir,I.C. enginecombustion and emissions.
4. Bejan, A., Advanced EngineeringThermodynamics, JohnWileyand Sons, 1988.

5. Rolman,J.P.,Thermodynamics, Fourth Edition, McGraw-RillInc., 1988
6. Smith, J.M. and VanNess., R.C., Introduction to Chemical Engineering Thermodynamics, FourthEdition, McGraw-RillInc., 1987.

AUT18R5014	ARTIFICIALINTELLIGENCEAppLICATIONSIN AUTOMOTIVEENGINEERING	L	T	p	C
		3	0	0	3

CourseOutcomes:

C01: Understand the basics of artificial intelligence and its different techniques
C02: Describethe various methods ofimplementationAIinIndustry
C03: Demonstrate theuseof AIin robotics
C04: Compare and contrast various kinds of motoniclogics
C05: Explain the application ofneural network inautomobileindustry

INTRODUCTIONTOARTIFICIALINTELLIGENCE

Introductiontoartificialintelligence-definition-A.Iapplications-A.Irepresentation-properties ofinternalrepresentation-heuristicsearchtechniques-bestfirstsearch,mean andendanalysis-A*andA0*algorithm-gameplaying-minimizeresearchprocedure-alphabetacutoffs-waitingforquiescence-secondary search.

AIINMANUFACTURING

Designandmanufacturing-AIintegrationthroughquality-intelligentsoftwaresystem forintelligent manufacturing -architecture for integrating enterprise automation - applicationofAIinindustries- utilizationandfunctionality-architectureof export system,knowledge representation,andtwocasestudiesonexpertsystems-knowledge basedexpert system-productandprocessdesign-relationsbetweenmanufacturingand AIresearchers.

AIINROBOTICS

Programmecontroland subroutines-communication anddataprocessing-monitormode commands-representing andrecognizing scenes,waltzalgorithm,constraint determination-trihedralfigures labeling knowledgerepresentationusingpredicatelogic- predicatecalculus-predicateandarguments-ISAhierarchy-framerotation,resolution - naturaldeduction-symbolicrepresentationandplanningforrobotcontrolsystemin manufacturing.

KNOWLEDGEREpRESENTATIONUSINGNONMONOTONICLOGIC

TMS(truthmaintenancesystem),statisticalandprobabilisticreasoning-fuzzylogic, structureknowledgerpresentation- semanticnet-frames,script-conceptualdependency planning-blockworld,strips-implementation usinggoalstack-nonlinearplanningwith goal stacks-hierarchicalplanning-list commitment strategy.

NEURALNETWORKS

Introductiontoneuralnetworksandperception-qualitativeanalysisonly,neuralnet architectureandapplication-naturallanguageprocessing andunderstandingand pragmatic, syntactic,semantic,analysis,RTN,ATN, understanding sentences.

References

1. ElaineRichandKerinKnight,ArtificialIntelligence,McGrawRill,1990.
2. KishenMehrotra,SanjayRawika,K.Mohan,ElementsofArtificialNeuralNetwork, MITPress,1996.
3. A.Fazel,Famili,DanaS.NauandstevenR.Kim.ArtificialIntelligenceApplication in Manufacturing.,AAAIPress,1992.
4. M. W. Firebaugh, Artificial Intelligence, Artificial knowledge based approach,BoydandFrasherPublishingCo,1988.

AUT18R5015	FINITEELEMENTANALYSISFOR AUTOMOTIVESYSTEMS	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Applymechanicsofmaterialsandmachinedesigntopicstoprovidepreliminary results used for testingthe reasonableness of finiteelement results.
CO2: Explaintheinnerworkingsofafiniteelementcodeforlinearstress,displacement, temperature and modal analysisfor2D Problems
CO3: Explain the inner workings of afinite element codefor isoparametricelements .**CO4:**Interprettheresultsoffiniteelementanalysesandmakeanassessmentofthe resultsintermsofmodeling(physicsassumptions)errors,discretization(meshdensity and refinement toward convergence)errors,and numerical (round-off) errors.
C05: Explain the advanced dynamic analysistechniques usingfinite element method

FINITEELEMENTANALYSIS
Ristoricalbackground- weighted residual methods- basic concept of fem-variational formulationofB.V.P.-Ritzmethod-finiteelementmodeling-element equations-linear and quadraticshapefunctions -bar,beam elements-applicationsto heat transfer.

FINITEELEMENTANALYSISOF2DpROBLEMS
Basicboundaryvalueproblemsin2dimensions-triangular,quadrilateral,higherorder elements-poisonsand laplaceequation-weakformulation- element matricesandvectors-applicationtosolidmechanics,heattransfer,fluidmechanics.

ISO-pARAMETRICFORMULATION
Natural co-ordinate systems -lagrangianinterpolationpolynomials –isoparametric elements –formulation - numerical integration - 1D, 2D, triangular elements – rectangularelements-illustrativeexamples.

SOLUTIONTOpLANEELASTICITYpROBLEMS
Introduction to theory of elasticity- plane stress- plane strain and axisymmetric formulationprinciplesofvirtualwork,consistentandlumpedformulation-useoflocal co-ordinates, element matrices usingenergyapproach.

SpECIALTOpICS
Dynamic analysis–equationofmotion-massmatrices-freevibrationanalysis-natural frequenciesof longitudinal- transverse andtorsionalvibration-introductiontotransientfieldproblem- nonlinearanalysis- use of softwares- handpelements-specialelement formulation.

References
1. M.AsgharBhatti,L.J.,FiniteElementAnalysis and Applications,JohnWiley,2005.
2. Rao,S.S.,Finiteelementmethodinengineering,Elseiver,2011.
3. Chandra guptaand Belagundu, Introduction to Finite elements in Engineering, Pearson, 2012.
4. Buchaman,G.R.,Schaum'soutlineoffiniteelementanalysis,McGraw-Rill Company,1995.

AUT18R5016	MODELING ANDSIMULATION OF AUTOMOTIVESYSTEMS	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Understand the basic consideration ofmodeling
CO2: Explain the concepts of spraymodeling
CO3: To analyzethe in-cylinder flow modeling
CO4: Classifythecombustion modelingand to analyzetheWeibe'sfunction
CO5: Studentsabletounderstandthesystemconceptandapplyfunctionalmodeling, Method to model the components

GENERALCONSIDERATIONSOFMODELING

Governingequations-conservationofmass,conservationof energy,conservation ofmomentum-numericalmethodology-computingmesh–Discretisation-gridformation.

SpRAYMODELING

Spray equation models- thin spray models, thick spray models- droplet turbulence interactions,dropletimpingementon walls-fullfield model, K-Model,

IN-CYLINDERFLOWMODELING

Laminarflowmodeling-probability density functions-Ekmanlayersroll-upvortex,vortex structures -compression generated turbulence, effective viscosity, and turbulent diffusivity.

INRODUCTIONTOCOMBUSTIONMODELING

Classification–zero dimensional modeling, quasi-dimensional modeling, multidimensionalmodeling-comparisonofdifferent combustionsystems,combustion efficiency,applications,classification-multizonemodels- heattransferCp-relations-Weibe'sfunctionanalysis- whitehouse-way model- twozonemodels-mathematical modelingofcatalyticconverters-onedimensional model–2Daxi-symmetricmodelof mono lithicreactor- computation of chemicalreactions.

ENGINESIMIUATION

Combustion in diesel engines–heat transfer in engines–heat transfer correlations-simulationofOtto cycle atfullthrottle, partthrottle andsupercharged conditions- progressive combustion–exhaustandintake processanalysis- engine andporting geometry-gas flow,scavenging.

References

1. Tarek Echekkiand Epaminondas Mastorakos, Turbulent Combustion Modeling,Springer,2011.
2. G. Stiesch, Modeling Engine sprayandcombustion processes,Springer,2003.
3. Joseph Colannino, Modelingof Combustion Systems, CRC press, 2006.

AUT18R5017	COMPUTATIONALFLUIDDYNAMICS	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Understand theimportanceof FDM
CO2: Understand of thebasic principles ofheat transfer
CO3: Recognizethetypeoffluidflowthatisoccurringinaparticularphysicalsystem and to usethe appropriatemodel equations to investigate theflow.
CO4: Demonstrate theunderstandingof fluid-flow study.
CO5: Analysisof acomplexfluid-flowproblems.

GOVERNINGDIFFERENTIALEQUATIONAND FINITEDIFFERENCE METHOD
Classification-initialandboundaryconditions-initialandboundaryvalueproblems-finitedifferencemethod-central,forward,backwarddifference-uniformandnon-uniformgrids-numerical errors-grid independencetest.

CONDUCTIONHEATTRANSFER
Steady one - dimensional conduction, two and three dimensional steadystate problems,transientonedimensionalproblem,two-dimensional transientproblems-steadyonedimensionaltransientproblems.

INCOMpRESSIBLEFLUIDFLOW
Governingequations,streamfunction–Vorticitymethod-determinationofpressure for viscousflow - Simple procedure of Patankarandspalding- computation of boundarylayerflow.

CONVECTIONHEATTRANSFER

Steady one-dimensional and two-dimensional convection–diffusion,unsteadyone-dimensionalconvection–diffusion-introductiontofiniteelementmethod–solution ofsteadyheatconductionbyFEM–incompressibleflow–simulationbyFEM.

TURBULENCEMODELS
AlgebraicModels–oneequationmodel,K- Models,standardandhighandlowReynolds numbermodels-prediction offluid flow and heat transfer usingstandardcodes.

References
1. OlegZikanov,Essentialcomputationalfluiddynamics,JohnWileyandSons.Inc, 2010.
2. Subas,V.Patankar,Numericalheattransferfluidflow,RemispherePublishing Corporation,1980.
3. T.J.Chung,ComputationalFluidDynamics,secondedition,CambridgeUniversity Press, 2010.

AUT18R5018	FLOW VISUALISATION TECHNIQUESFOR I.C. ENGINES	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: To Understand thefunction ofinstrumentation forflowvisualisation
CO2: To acquireknowledgein design of optical engineand engine optical techniques
CO3: Explain the visualization of in cylinder flow by laser sheet method and photographic measurement techniques
CO4: To acquirebasic knowledge in combustion visualisationlike endoscopes, advanced camerasand optictools
CO5: Analyzethegeometricflow and surfaceflow visualisation

INSTRUMENTATION FORFLOW VISUALISATION
Schilierenphotography–Laser Velocimetry –Illuminated Particle Visualisation Rolography–ParticleImageVelocimetry.

FLOW VISUALISATION OFINTAKEpROCESS
Engineopticalaccess,Designofopticalengine,Thermalpropertiesofmaterialsusedfor optical engine, processingof materials–Optical techniques.

IN-CYLINDERFLOW
VisualExperimentofIn-cylinderflowbyLasersheetmethod.Intakeflowvisualization bylight colourlayer examination ofprinciple andphotographic measurement techniques.

COMBUSTION VISUALISATION
Endoscopes, Advancedcameras,FiberOptic Tools,Laser diagnostics ofFlames.

NUMERICALFLOW VISUALISATION
Direct, Geometricand texture based flow visualization, Dense Geometric Flow visualization–Surfaceflow visualisation.

REFERENCES:
1. A.J.SmitsandT.T.Lim, Flow Visualization Techniques and Examples, Imperial College Press, 2012.
2. J.P. Rolman,Experimental Methods forEngineers, McGraw–RillInc., 2001.
3. WolfgangMerzkirch, Flow Visualisation, 2nd Edition, AcademicPress, 1987.

AUT18R5019	SIMULATIONOFI.C. ENGINE COMBUSTION pROCESS	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Ableto describe all kind ofthermodynamiccombustion changes in an engine.
CO2: To simulate SI engine with adiabatic combustion, fuel vaporization and full throttle operations.
CO3: Todistinguishprogressivecombustionwithgasexchangeprocessandvalidate pressurecrankangle diagram.
CO4: To analyze compression ofsimulated valves and heat transfer process.
CO5: To calculate simulation ofCIengine performance and pollution estimation.

SIMULATION pRINCIpLES
Firstandsecondlawsofthermodynamics–Estimationofpropertiesofgasmixtures-Structureofenginemodels–Openandclosedcyclemodels-Cyclestudies.Chemical Reactions,Firstlawapplicationtocombustion,Reatofcombustion– Adiabaticflame temperature.RessLaw-Lechatlierprinciple.Reat transferinengines–Reattransfer modelsfor engines. Simulationmodelsfor I.C.Engines. (Idealandactualcycle simulation) Chemical Equilibrium and calculation of equilibriumcomposition.

SIMULATION OFCOMBUSTION IN SI ENGINES
CombustioninSIengines,Flamepropagationandvelocity,Singlezonemodels–Multi zonemodels–Massburningrate,Turbulencemodels–Onedimensionalmodels–Chemical kinetics modeling –Multidimensional models, Flow chart preparation.

SIMULATION OFCOMBUSTION IN CI ENGINES
CombustioninCIenginesSinglezonemodels–Premixed-Diffusivemodels–Wiebe' model–Whitehousewaymodel,Twozonemodels-Multizonemodels-Meguerdichianand Watson'smodel,Hiroyasu'smodel,Lyn'smodel–Introduction to Multidimensional and spraymodeling, Flow chart preparation.

SIMULATION OFTWO STROKE ENGINES
Thermodynamics of the gas exchange process - Flows in engine manifolds –One dimensional and multidimensional models, Flow around valves and through ports Modelsforscavengingintwostrokeengines– Isothermalandnon-isothermalmodels, ReatTransferandFriction.

SIMULATION OFGASTURBINE COMBUSTORS
GasTurbinePowerplants–Flamestability,CombustionmodelsforSteadyFlow-Simulation–Emission models. Flow chart preparation.

References
1. Joseph Colannino, Modelingof Combustion Systems, CRC press, 2006.
2. V.Ganesan, Computer Simulation of Spark Ignition Engine Processes, Universities Press, 2000.
3. CohenR.RogersGEC.–GasTurbineTheory–PearsonEducationIndiaFifth edition, 2001.

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

CourseOutcomes:
CO1: To gain theknowledge about thefundamentals of anIC engine
CO2: Understand the concepts of variousenginecomponents design
CO3: Abilityto design engine subsystems
CO4: Ravegood knowledgeand design of two stroke engine systems
CO5: Students able to understand the system concept and applyfunctionalmodeling method to model the engine components.

FUNDAMENTALS STUDIESFOR ENGINE DESIGN
Principleofsimilitude,Choiceofmaterial,mechanicalpropertiesofmaterialandNoise, VibrationandRarshnessconsiderations(NVR),Engineperformance characteristics, Basicsof ignitionandfuelinjections, cylinder arrangements,static anddynamic balance, borestrokeratio calculation.

DESIGN OF FOREMOST ENGINE COMpONENTS
Designofpiston,pistongrownorbowldesign,pistonringsandpin,powercylinder system, cam shaft, connecting rod assembly, crankshaft, valve gearing mechanism, cylinder block, cylinder-headanalysisof stress fluctuations.

DESIGN OFENGINESUBSYSTEMS
Inletandexhaustmanifolds,crankcase,enginemountings,gaskets,bearings,flywheel, turbocharger,supercharger,computercontrolledfuelinjectionsystem,lubricationand coolingsystem design. Design of mufflers.

DESIGN SpECIFICSOFTWO-STROKE ENGINE SYSTEMS
Arrangementandsizingofports,engineandportgeometry,pistonassembly,intakeand exhaustsystem,scavengingratioand deliveryratio,experimentations inscavenging flow, design of combustion chamber,cylinder trap design.

CONCEpTSOF COMpUTERAIDED DESIGN
Preparation ofphysicalgeometry,strategicplanning, partmodelling procedure,meshing techniques,1D,2Dand3Dmeshing,elementquality analysis,assigning materials property inmodel,Boundary conditions,linearandnonlinearanalysis,postprocessing techniques.

References
1. Vehicular EngineDesign, KevinL. Roag,SAEInternational USA
2. Designandsimulationoftwostrokeengine,GordanP.Blair,SocietyofAutomotive Engineers,Inc, 1996.
3. Springer –Verlag, Wien, Austria, 2006.
3. EngineeringDesign,ASystematicApproach,G.Pahl,W.BeltzJ.Fieldhusenand K.R.Grote, Springer
4. InternalCombustionEngineFundamentals,JohnB.Reywood,McGraw–RillBook Company, 2012.
5. InternalCombustionEngineDesign,A.KolchinandV.Demidov,MIRPublishers, Moscow, 1984.

AUT18R6001	VEHICLE DYNAMICSANDSTRUCTURES	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Understandthebasicofmechanicalvibrationunderfree,forced anddamped conditions
CO2: Estimatethe multi degreeof freedom systems forreducingvibration in vehicles
CO3: Identify, check and test thesuspension and tyrecharacteristics
CO4: Applythe concept of vehiclehandlingsystem
COS: Explain the concepts of load distribution invehicles and stabilityofthe vehicles

FUNDAMENTALSOF VIBRATION

Classification ofvibration, definitions, mechanical vibrating systems, mechanical vibration andhuman comfort. Modeling andsimulation studies. Single degreeof freedom,free,forcedanddamped vibrations.Magnificationfactorandtransmissibility. Vibrationabsorber.Vibrationmeasuring instruments.Twodegreeoffreedomsystem, modal analysis.

HANDLINGCHARACTERISTICSOFVEHICLES

Steering geometry. Steady statehandling characteristics. Steady stateresponse to steeringinput. Transientresponse characteristics.Directional stabilityof vehicle.

TYRES

Tireforcesandmoments,rollingresistanceoftires,relationshipbetweentractiveeffort and longitudinal slip of tyres, corneringproperties of tyres, ridepropertiesof tyre.

pERFORMANCECHARACTERISTICS OFVEHICLE

Equation ofmotion and maximumtractive effort. Aerodynamics forces andmoments Powerplantandtransmissioncharacteristics.Predictionofvehicle responsetobraking, crashworthiness of avehicle.

DYNAMICS OFSUSpENSIONSYSTEM

Requirementsofsuspensionsystem.Spring massfrequency,wheelhop,Wheelwobble, wheelshimmy,choiceofsuspensionspring rate.Calculationofeffectivespring rate. Vehicle suspensioninforeandaft,Rydraulicdampersandchoice ofdamping characteristics.Compensated suspensionsystems.Rumanresponse tovibration,vehicle ridemodel.Load distribution. Stabilityon a curved track, banked roadandon aslope.

References

1. Groover,"MechanicalVibration",7thEdition,NemChand&Bros,Roorkee,India, 2003.
2. W.Steeds, 'Mechanicsofroad vehicle'IlliffeBooksLtd,London 1992
3. JG.Giles, 'Steering,Suspension tyres',IllifeBooksLidLondon 1975
4. P.M.Heldt, 'Automotivechassis',Chilton Co ., Newyork, 1982
5. J. R. Ellis, 'VehicleDynamics',BusinessBooks,London, 1969.

AUT18R6002	HEAT TRANSFEREQUIpMENTDESIGN	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: To discuss the Shelland tube heat exchanger and to perform thecalculations
CO2: Understand theworkingof plate and spiral plate heat exchanger
CO3: To be able to solvethe problems in heat exchanger equipment's
CO4: To solve the problems to enable the design and analysis of Compact heat exchangers
COS: Understand theworkingofvarioustypesofcoolingtowersandtosolvethe problems in coolingtowers

SHELL AND TUBEEXCHANGERS

Classificationofheattransferequipment-Designofshellandtubeheatexchanger-Finned surfaceheatexchanger-Reatexchangersforspecial services-Firedheaters

pLATEHEAT EXCHANGERS

Plateandspiralplateheatexchanger-plateheatexchangerforDairyindustry-Reat Pipes –Application and Limitations

DESIGN OFHEAT EXCHANGERS

ThermaldesignofheatexchangeequipmentssuchasAirpre-heaters,Economizer-Superheater andcondensers.

COMpACTHEAT EXCHANGERS

Introductiontocompactheatexchangers-Selectionofcompactheatexchangers–design ofcompactheatexchangers-applicationofcompactheatexchangers-limitationscompact heat exchangers

COOLINGTOWERS

Introductiontocoolingtowers-classificationofcoolingtower-Analysisanddesignof coolingtowers-application and limitation of coolingtower

References

1. ManfredNitsche,ROGbadamosi, ReatExchanger DesignGuide:A PracticalGuide for Planning,SelectingandDesigning ofShellandTubeExchangers,Butterworth-Reinemann,2015.
2.J.E. Resselgreaves,RichardLaw, DavidReay,CompactReatExchangers: Selection, Designand Operation, Butterworth-Reinemann,Second edition, 2016.
3.D.A.Reay,P.A.Kew,R.J. McGlen,ReatPipes:Theory, DesignandApplications, Sixth Edition, 2014.
4. Kakac, S. andLiu,R.,ReatExchangers, CRC Press, 2002.
5.G.B.Rill,E.J.Pring, PeterD.Osborn,CoolingTowers:PrinciplesandPractice, Butterworth-Reinemann,2013.

AUT18R6003	ADVANCEDHEATTRANSFER	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Abilityto understand and solve conduction,convection and radiationproblems **CO2:** Understand thegoverning equations, energy equations and free and forced convections
CO3: Abilityto design and analyzetheperformanceof heat exchangers and evaporators
CO4: Abilityto design and analyzereactor heatingandcoolingsystems
COS: Understandand solve mass transfer and heat transfer problems

CONDUCTIONANDRADIATIONHEATTRANSFER

One dimensionalenergy equations and boundary condition- threedimensionalheat conductionequations- conductionwithheatgeneration-extendedsurfaceheattransfer-transientandperiodicheatconduction.

FREEANDFORCEDCONVECTIVEHEATTRANSFER

Dimensional analysis- boundarylayerconcept-basicgoverningequations- freeand forcedconvection-momentumandenergyequations- turbulentboundarylayerheattransfer-mixinglengthconcept-turbulencemodel-K-Emodel-analogybetween Reatandmomentumtransfer-Reynolds,Colburn,VonKarman,Turbulentflowina tube-highspeedflows.

pHASECHANGEHEATTRANSFERANDHEATEXCHANGERCondensationwithsh earedgeonbankoftubes,boiling–poolandflowboiling- heatexchanger- E-NTUapproachanddesignprocedure-compactheatexchangers.

RADIATION

Basic lawsof radiation- radiationinidealandrealsurfaces- viewfactoralgebra- radiation shields-electricalanalogy using radiosityandirradiation -radiation in gaseousandvapours.

MASSTRANSFERANDENGINEHEATTRANSFERCORRELATION

Mass transfer- vaporizationofdroplets-combinedheatandmasstransferproblems- heat transfer correlations inI.C.engines.

References

1. Eckert, E. R. G. and Drake, R. M., Analysis of Reatand Mass Transfer, McGrawRillCo.,1980.
2. Ozisik,M.N.,ReatTransfer,Basicapproach,McGrawRillCo.,1985.
3. Bejan,A.,ConvectionReatTransfer,JohnWileyandSons,1984.
4. Rohswnow,W.M.,Rarnett,J.P.,andGanic,E.N.,RandbookofReatTransfer Applications,McGrawRill,NewYork1985.
5. Patankar. S.V., Numerical heat transfer and Fluid flow, Remisphere PublishingCorporation,1980.
6. Carnahan,B.,Luther.R.A.,andWilkes,J.O., Applied Numerical Methods, WileyandSons,1976.

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

CourseOutcomes:

CO1: UnderstandtheBasicprinciplesandClassify varioussensors,actuatorssystemsin mechatronics

CO2: Explain various control systems in mechatronics

CO3: To understand thefunction ofvarious components of mechatronics systems

CO4: To introducethe basics ofmicroprocessorsand microcontrollers technology

COS: To develop the student's knowledge in various robot structures and skills associatedwith robot control

INTRODUCTION TOMECHATRONICS

Introduction toMechanical, Electrical, Fluid and Thermal Systems. Rotational and Transnational systems,electro-mechanical,hydraulic-mechanical systems. Basic principles,characteristicsandselectionissuesfor typical SensorsIActuatorsusedin mechatronics. Integration Electronics, Controls, Information technology with Mechanical system.

CONTROL SYSTEMS

ControlSystems:Openloop,Closeloop,Transferfunction,FeedbackandFeed-forward System.Response,modeling ofdynamicsystem,Dynamic response ofFirst,Second OrdersystemstoStep,RampandImpulseinputs.Bodeplotandstability ofsystems. Control actions, P,I, D.

COMpONENTSOFMECHATRONICS SYSTEMS

Stress, Strainand Force measurement using strain gauges. Study ofdevices as Accelorometers,tachometers,velocity measurement,potentiometers.Modelingof sensors,Modeling ofActuators,Steepermotors,DCIAC servos, Solenoids,Rydraulicand Pneumatic actuators, Piezo-electric sensorsandactuators, Shape memory alloys.Signalconditioning, Operationalamplifier, Protection, Filtering,Digitalsignal, Data acquisition usingDAQBoard, Digital signal processing, A2D, D2A convectors.

DIGITAL LOGIC CIRCUITS

Number system, Combinational and Sequential circuits. Boolean algebra, binary I floatingpointarithmetic,Micro-processorbuilding blocks,Terminology,Intel8085,a microprocessorandaMicro-controller,Flowcharts,Assembly language,Instructionset, sample programs,Structure ofPLC,IIO Processing, Programming.Casestudies:Data acquisition,Data acquisitionandControl,MatLabData acquisitionapplicationfor controls

ROBOTICS ANDAUTOMATION

Robotanatomy,StructureofRobots,PointtoPointandContinuouspathRobots,Robot Gripper, Sensors, Control systems, Sensors & Vision system in control, Actuators, modeling andcontrolofasinglejoint,Kinematics,Transformationmatrices,Linkand Jointdescription,D-Rparameters,Directkinematics,Inverse kinematics,Velocitiesand static forces in manipulator.

Reference

1.RichardD.Klafter,ThomasA.Chemielewski,MichaelNegin,RoboticEngineering : AnIntegrated Approach,PrenticeRallIndia, 2002.
2.IntroductiontoMechatronicsandMeasurementSystems,DavidAlciators&Michael B. Ristand,Tata McGraw Rills,India, 2001.
3. W. Stadler, AnalyticalRobotics and Mechatronics, McGraw Rill,1994.
4.D.M.AuslanderandC.J.Kempf,Mechatronics:MechanicalSystem Interfacing, PrenticeRall,1995.5.D.ShettyandR.Kolk,MechatronicSystemsDesign,WadsworthPubl., 1997.

AUT18R6005	AUTOMATIC CONTROL ENGINEERING	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Describethe workingoffeedbackcontrol systems and control systemcomponents
CO2: Understand thePPI and PID controllers design and robust control
CO3: Abilityto design andanalyzebodeplots and polar plots
CO4: To learnabout theBIBO stability andNyquiststability
COS: To gain and knowledge about theMATLABanalysisand solvetheproblems

BASICCONCEpTSANDSYSTEMREpRESENTATION

Terminology andbasicstructure-feedback control theory -multivariable systems - dynamicmodels-state variable models-impulse response modelsandtransfer functionmodels-
applicationtomechanical,thermal,hydraulic,pneumaticandelectromechanicalsystems-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

Performance specifications- correlation to timedomain specifications-bodeplotsand polarplots-gainandphasemargin-constantMandNcirclesandNicholschart–non-minimumphasesystems.

STABILITY

BIBO stability, Routh-Rurwitzcriterion, stability ranges for aparameter –Nyquist stabilitycriterion-relativestabilityassessmentusingRouthandNyquistcriterionand bodeplots.

COMpENSATIONDESIGN

Design concepts-realisationofbasic compensation-cascade compensation in timedomainandfrequencydomain, simple MAT LAB applications to analysis and compensators designproblems.

References

1. Ogatta,ModernControlEngineering,TataMcGrawRill,NewDelhi,1997.
2. NagarathI.J.andGopalM.,ControlSystemEngineering,WileyEasternLtd.,Reprint,1995.
3. Dorf, R.C. and BishopR.R.,Modern Control Systems, AddisonWesley,Boston,1995.
4.LeonardN.E. and WilliamLevine, Using MATLAB to Analysis and Design ControlSystems,Addison Wesley,Boston,1995.

AUT18R6006	AUTOMOTIVE ELECTRICAL AND ELECTRONICS	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Understand thefundamentals of electricaland electronics systems.
CO2: Understand the concept of battery, sensor and actuatorsoperation and its necessity
CO3: Examiningthe workingof startingsystemand chargingsystem of automotive
CO4: To analyseengineignition system characteristics.
COS: Recognize andunderstand the different wiring diagrams used in automobile manuals.

FUNDAMENTALSOFAUTOMOTIVEELECTRICALSYSTEMS
Battery-principle,constructionandcharacteristics–batteryratingcapacity–efficiency ofbatteries-various testson batterycondition–electricpower steering.

CHARGINGANDSTARTINGSYSTEMS
Chargingprinciples,circuits–generationofdirectcurrent,shuntgeneratorcharacteristics, voltageandcurrent regulator, compensated voltage regulator -alternators, behaviourofstarterduring starting,working ofdifferentstarterdrive units,careandmaintenanceofstartermotor,newdevelopmentrequirementsof startersystem.

FUNDAMENTALSOFAUTOMOTIVEELECTRONICSYSTEMS
Electronicmanagementofchassissystem–vehiclemotioncontrol–automotive microprocessor uses–electronicdashboardinstruments–onboarddiagnosissystem– electroniccontrolofbrakingandtraction-automatictransmission,electronicclutch.

IGNITIONSYSTEMS
Typesofsolidstateignitionsystemsandtheirprincipleofoperation,advantagesof electronicignitionsystems,contactlesselectronicignitionsystem,distributorlessignition,elec tronicsparkstimin gandcontrol,sparkarrester,throttlebodyinjectionandmulti-portorpointfuelinjection.

SENSORSANDACTUATORS
Introduction, basicsensorsarrangement, typesofsensors–oxygensensors,crankangle position sensors –fuel metering and vehicle speed sensors and detonation sensors, altitude sensors,flowsensor,throttlepositionsensors,solenoids,steppermotors,relays, MicrocontrollerapplicationinICEngine.

References
1. Young, A. P.andGriffiths, L., Automobile Electrical Equipment, EnglishLanguagesBookSocietyandNewPress,1990.
2. Vinal,G.W.,Storagebatteries,JohnWileyandSonsInc.NewYork,1985
3. Crouse,W.R.,AutomobileElectrical Equipment, McGraw Rill Book Co. Inc. NewYork,1980.
4. SpreadBury,F.G.,ElectricalIgnitionEquipment,ConstableandCo.Ltd.,London,1962.
5. Kholi,P.L.,AutomotiveElectrical Equipment, TataMcGraw-Rill CoLtd, NewDelhi,1975.

AUT18R6007	AUTOMOTIVECONTROLSYSTEMS	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: To learnabout thedifferent vehicleparameters in vehicle
CO2: Describethe workingof various enginecontrol systems
CO3: To gain knowledge about the engine management control systems in vehicle
CO4: To know about thedriveline control systems of cars
COS: To know about thevarious enginemanagement control systems invehicles

VEHICLEpARAMETERSANDSTATES
Vehiclevelocityestimation,sensordataprocessing,Kalmanfilterapproach,vehicle yaw rate calculation, fuzzy systems, calculations of wheel ground contact force, determinationof roadgradient, vehiclebodyslipangleobserver.

ENGINECONTROLSYSTEMS
Enginemodelforlambdacontrol,adaptivecontrolcircuit,idlespeedcontrol, knock sensorcontrol,cylinderbalancing,stationaryengineoperationcontrol,sensor signal processing,energyconversionandtorquemodel,adaptations ofinjectionmap.

DRIVELINECONTROLSYSTEMS
Basicdrivelineequation,controlandmodelingofneutralgear,controllerformulation, drivelinecontrolwithLQGILTR,driveline speedcontrol,RQV control,speedcontrol withactive damping,driveline controlfor gear shifting,transmission-torque control criterion, anti-jerking control forpassenger cars.

ENGINE MANAGEMENT CONTROL
Effective work of engine, air-fuel ratio, inflammation of air-fuel mixture, flame propagationcontrolunitandenergyconversion,intermittentfuelinjection,injection timingcontrol module, ignition angle control.

DIAGNOSIS
Introductiontodiagnosis,modelbaseddiagnosis,faultmodelling,residualevaluation, airintakesystemdiagnosis,misfiredetection,crankshafttorquebalance,andcasestudies of model based diagnosisforSIengines.

References

1. UweKiencke, LarsNielsen, Automotive control systems, 2nd Edition, springer, 2005.
2. A. GalipUlsoy,RueiPeng,MelihCakmak,AutomotiveControl Systems, 2014
3. WeiLiu,Introduction toRybridVehicleSystemModelingand Control, 2017
4. "AutomotiveEngines:Control,Estimation,StatisticalDetection"byAlexanderA Stotsky, springer, 2009
5. "AdvancedTopicsinControlSystemsTheory"byJulioAntonioLoriaPerezand FrancoiseLamnabhi-Lagarrigue,Springer,2006

AUT18R6008	AUTOMOTIVE AIR CONDITIONINGAND CLIMATE CONTROL	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: To identifyand describethe principles of the air conditioningsystem.
CO2: To applythe concept of heatingin theair conditioningsystem.
CO3: To describethe workingprinciples refrigeration system
CO4: To identifythe components of thetemperaturecontrol devices in anautomobile.
COS: To maintain and servicethe air conditionerof an automobilein caseof afailure.

FUNDAMENTALS
Terminology, designfactors and concepts related to air conditioning system - ConstructionandWorking principlesofThermostaticExpansionvalveandOrificetube based system-Reatingsystem types-detailedstudy ofRVACcomponentslike compressor,evaporator,condenser,TXV,orificetube,Receiver-drier, heatercoreetc. Location of airconditioningcomponents in avehicle.

REFRIGERANTS&AIR MANAGEMENT SYSTEMS
Refrigerants: Temperature andpressure relation, Properties of R-12 and R134a-refrigerantoil.Simpleproblems-Containers-Randlingrefrigerants-Tapping intothe refrigerantcontainer- OzoneLayerDepletion.Air managementsystem:Air routingfor manual,semiandautomatic system-casesandducts- Air distribution,controlheadand doors-Defrost system

AUTOMATIC CLIMATE CONTROL SYSTEM
Blockdiagram -types ofSensors and Actuators,-Control LogicElectrical 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-CONDITIONINGCOMpONENTS
ModelingofFixedandvariableDisplacementtypecompressor,evaporatormodeling-heattransfercorrelationsforthefluidsinsidetheevaporator,analysisofevaporator frosting-condenser modeling-improvement ofrefrigerant flowcontrol method.

AIRCONDITIONING DIAGNOSIS ANDSERVICES
ACsystemdiagnosisbasedontemperatureandpressuremeasurements,sightglass, soundetc.- refrigerantleak detection-Troubleshooting andServicing ofcompressor, evaporator,condenser,heatercoreetc.–RVACequipment,recoveryandcharging.Air routingsystem service.

REFERENCES
1) Goings.L.F., "Automotiveair conditioning",American Technical services, 1974
2) Paul Weiser, "Automotiveair conditioning",Reston PublishingCoInc., 1990.
3) MacDonald, K.L.,"Automotiveair conditioning",TheodoreAudel series,1978.
4) JamesD.Halderman,"AutomotiveHeating,Ventilation,andAirConditioning Systems",Pearson EducationInc., 2004.

AUT18R6009	TRIBOLOGYINDESIGN	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: To understand thebasic principles of tribology
CO2: To describethe basic principles and types of friction and wear
CO3: To understand thenecessityof lubrication and to studythe theory
CO4: Design and performance analysisoffluid filmbearings
COS: To evaluatethe load, stress and lifecapacityof rollingelement bearings

BASIC pRINCIpLESOFTRIBOLOGY
Introductiontotheconceptoftribodesign,specificprinciplesoftribodesign,tribological problemsinmachine design,Basic principlesintribology.Nature ofengineering surface, surfacetopography, Measurement ofsurfacetopography.

CONTACT BETWEEN SURFACES
Contact betweensurfaces, Elastic and plastic deformation, surface and subsurface stresses,surfacetension,surface energy,Frictiontheory,Junctiongrowth,Frictiondueto plugging, adhesion, deformation, Friction undercomplex, motion conditions. Friction characteristics ofmetal and non-metals, rollingfriction, Friction measurements.

TYpESOFWEARAND THEIR MECHANISMS
Adhesivewear,MaterialselectionforAdhesivewearsituation,Abrasivewear,Materials foradhesivewearsituation,wearduetosurfacefatigue,wearduetochemicalreaction, wear measurements, wear ofnon-metals.

LUBRICATION THEORY
Composition and properties of oil and Grease lubricants, Gas lubricants, Viscosity measurements,ASTMstandardsLubricationregimes,externally pressurizedlubrication, Rydrodynamiclubrication,Elastohydrodynamic,Boundary andsolidlubrication. Performance analysisof thrustbearingsandjournalbearing. SelectionandDesign considerations,DesignprocedureReynoldsEquationwithpressureandviscosity effects, Film thickness equation.

SURFACE ENGINEERINGIN TRIBOLOGY
Introduction, Surfacemodifications, Thermo–Chemical processes, Surfacecoatings.

References
1. GwidonW.Stachowiak,AndrewWBatchelor,"EngineeringTribology" Elsevier Science, 4th Edition, 2013.
2. PrasantaSahoo, "EngineeringTribology",PHILearningPvt.,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-Reinemann,2017.

AUT18R6010	METALFORMINGFORAUTOMOTIVE INDUSTRIES	L	T	p	C
		3	0	0	3

CourseOutcomes:

CO1: Analyzethe various sheet metal formingprocess in automobiles
CO2: UnderstandtheworkingofvariousdrawingprocessandAdvancedtechniquesof Sheet Metal Forming
CO3: To gain knowledge about the advanced metal formingprocess
CO4: To analyzethe defects of advanced metal formingprocess and drawingprocess
COS: Knowthe differenttestingof tensiletest, flexural test, fracturetoughness

SHEET METAL FORMINGINAUTOMOTIVE ENGINEERING

Forging - Open die forging, Impressionlcloseddie forging, Stamping,Extrusion,Spinning, Shearing, Laser Cutting, Rot Forming, Superplastic forming,Stretchforming,Rydroforming,ElectromagneticForming,

DRAWING

Drawingoftubes,rods,andwires:Wiredrawingdies,tubedrawingprocess,analysis ofwire, deep drawing and tube drawing.SheetMetal forming: Forming methods, Bending,stretchforming,spinning andAdvancedtechniquesof SheetMetalForming, Forminglimit criteria, defect in formed parts.

ADVANCEDMETAL FORMING pROCESSES

RighVelocity Forming,Explosiveforming,ElectrohydraulicForming, RERF, Electromagneticforming,residual stresses,in-process heat treatment, computer applicationsinmetalforming.Presstooldesign:Designofvariouspresstoolsanddies likepiercing dies,blanking dies,compounddiesandprogressiveblankingdies,designof bending,forming and drawingdies.

METAL FORMINGDEFECTS

Defectsinforgingprocess,Defectsinsheetmetalforming,defectsinextrusionprocess, defects in advanced forming process, defects in drawing process –advantages and disadvantages.

TESTINGFOR AUTOMOTIVE COMpONENTS

Simple Tensile Test, Tensile test with r- and n-value determination,BiaxialTensile Test,FractureToughness Testing,FlexureTest,DrawBead Test,Righ-Speed Tensile Test,Disk flexuretest

References

1. GeorgeE.Dieter,"MechanicalMetallurgy",McGraw-Rill BookCo.,NewYork, 1986.
2. Z. Marciniak, J. L. Duncan, S. J. Hu, "Mechanics of Sheet Metal Forming", Butterworth-Reinemann,2002.
3. SingC.Tang,JwoPan,"MechanicsModelingOfSheetMetalForming",SocietyOf Automotive EngineersInc, 2007.
4. Edward Hoffman, "Jigand FixtureDesign",CengageLearningUS, 2004.

AUT18R6011	LEANBURN ENGINES	L	T	p	C
		3	0	0	3

CourseOutcomes:
CO1: Knowthe basicsfundamentals of RCCIengine
CO2: Understand thefunctioningofgasolineanddiesel RCCIcombustion engines
CO3: Understand the control methods of RCCIengine
CO4: Acquiretheinformationonfuelrequirementsandcombustionwithalternative fuels related to RCCIengine
COS: To learnabout theCharacteristics of combustion and exhaust emissions

HCCI ENGINEFUNDAMENTALS
IntroductiontoRCCI,Controlledautoignition(CAI),BasicsofRCCIlCAIprocesses, ComparisonofSI andCAI combustion,MethodstoobtainCAI,CAIoperation,Regimes of RCCIand Conventional EngineOperation

GASOLINE ANDDIESEL HCCI COMBUSTION ENGINES
ConventionalGasolineCombustion,EffectsofEGR,TechniquestoRCCIoperationin gasoline engines,ConventionalDieselCombustion,Overview of dieselRCCIengines, Techniques –Early Injection, Multiple injections, Narrow angle direct injection (NADI™) concept.

HCCI CONTROL
ControlMethods,Combustiontimingsensors,RCCIlSIswitching,Transitionbetween operating modes(RCCI-SI-RCCI),Fueleffects inRCCI-gasoline,diesel,auto-ignition requirement,combustionphasing,Influence of equivalenceratio,auto-ignitiontiming, combustion duration, auto-ignitiontemperature and auto-ignitionpressure, Combustion limits,IMEPandindicatedefficiency,other approachestocharacterisingfuel performancein RCCIengines.

HCCI FUELREQUIREMENTS &COMBUSTION WITH ALTERNATIVE FUELS
Introduction, Background, Diesel fuel RCCI, RCCI fuel ignition quality, Gasoline RCCI,RCCIfuelSpecification,Fundamentalfuelfactors. NaturalgasRCCIengines, CNG RCCIengines,methaneln-butanelair mixtures.DMERCCIengine-chemical reaction model, Combustion completeness, Combustion control system, Method of combiningDME and other fuels, 'unmixed-ness' of DMElair mixture

LOW-TEMpERATUREAND pREMIXEDCOMBUSTION
Basicconcept,Characteristicsofcombustionandexhaustemissions,modulatedkinetics (MK)combustion–First and Second generation of MK combustion, Emission, performanceimprovement.

REFERENCES:
1. HuaZhao,'HCCI andCAIEnginesforautomotiveindustry,WoodHead Publishing, 2007.
2. B.P.Pundir,'I.C. EnginesCombustionandEmission',NarosaPublishingHouse, 2017.
3. V.Ganesan,'Internal CombustionEngines' McGrawHillBookCo,4th Edition, 2017.
4. J.B.Heywood,'Internal CombustionEngineFundamentals' McGrawHillBook Co, 2017.

GeneralElectives

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EEE18RS020	SOFTCOMPUTINGTECHNIQUES	L	T	p	C
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INTRODUCTION ANDFEEDFORWARD NEURALNETWORK

Introductiontosoftcomputing-softcomputingvs hardcomputing-various types of soft computing techniques-applications ofsoft computing-Neuron-Nerve structure and synapse-ArtificialNeuronanditsmodel-activation functions-Neuralnetworkarchitecture-single layer and multilayer feed forward networks-McCullochPittsneuron model-perceptron model - Adaline and Madaline-multilayer perception model-back propagation learning algorithm-Implementbackpropagation learningalgorithmusingMatlabToolbox.

RECURRENTNEURALNETWORKS

Counter propagation network-architecture-functioning &characteristics of counter-Propagation network-RopfieldlRecurrentnetwork-configuration-stability constraints-associativememory-andcharacteristics-limitationsandapplications-RopfieldvlsBoltzmanmachine-Adaptive Resonance Theory-Architecture-classifications-Implementation and training-Associative Memory-Designofmultilayerfeedforwardnetworkusing MATLAB Toolbox.

FUZZYLOGICSYSTEM

Introductiontocrispsetsandfuzzysets-basicfuzzysetoperationandapproximatereasoning.
Introduction tofuzzy logic modeling and control-Fuzzification-inferencing and defuzzification-Fuzzy knowledgeandrulebases-Fuzzy modelingandcontrolschemesfor nonlinearsystems.Self-organizingfuzzy logiccontrol-Fuzzy logiccontrolfornonlineartime delaysystem-DevelopmentofNeurofuzzy systemusingMATLAB toolbox.

GENETIC ALGORITHM

BasicconceptofGeneticalgorithmanddetailalgorithmicsteps-adjustmentoffreeParameters-Solutionof typicalcontrolproblemsusinggeneticalgorithm-Conceptonsomeothersearch techniques like tabusearch and ant colony search techniques for solvingoptimization problems-Implementation ofoptimizationproblemusingMATLABToolbox.

AppLICATIONS

GAapplicationtopowersystemoptimizationproblem-Casestudies:Identificationandcontrol of linearandnonlineardynamicsystemsusingMatlab-NeuralNetworktoolbox. Stability analysisofNeuralNetworkinterconnectionsystems-Implementationoffuzzy logiccontroller usingMatlabfuzzy logictoolbox-Stabilityanalysisoffuzzy controlsystems.

TextBook(s):

1.S.N.Sivanandam, S.N.Deepa,"PrinciplesofSoftComputing"2nd Edition,Wiley,2011.
2.Fakhreddine0.KarrayandClarenceDeSilva,"Soft Computing&IntelligentSystem: Theory,ToolsandApplications",Firstedition,PearsonEducation,2009.

Reference(s):

1. LaureneV. Fausett, Fundamentalsof Neural Networks: Architectures, Algorithms And Applications,PearsonEducation. 2004
2.TimothyJ.Ross,"FuzzyLogicwithEngineering Applications"WileyIndia.,2010.

EEE18R6013	EVOLUTIONARY COMpUTATION TECHNIQUES	L	T	p	C
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EVOLUTIONARYCOMpUTATION(EC): THEBACKGROUND

OutlineofEvolutionaryAlgorithms(EA)–EATerminologies–RobustadaptationandMachine Intelligence–PrinciplesofEvolutionaryProcesses–PrinciplesofGenetics–No-free Lunch theorem forEA –Advantages of EA over other approaches.

GENETIC ALGORITHM (GA)

Binary GA–genetic operators –Tournament, Proportionate and Ranking Selection – Singlepoint,two-pointanduniformcrossover–Elitism–RealParameterGA–Linear,naive, blend and Simulated Binary Crossover –Random, Non-uniform, Normally distributedand Polynomial Mutation–ConstraintRandlingTechniques in GA.

EVOLUTIONARYSTRATEGIES(ES) &EVOLUTIONARYpROGRAMMING(Ep)

Non-RecombinativeES–RecombinativeES–SelfAdaptiveES–ConnectionbetweenRGA and Self adaptive ES –Evolutionary Programming(EP) –EP and ES: Similarities and Differences –Genetic Programming (GP) –Population size and Dynamics –Convergence and StoppingCriteria –Exploration and Exploitation.

Unit 4:pARTICLESWARMOpTIMIZATION(pSO)

ConceptsandformulationSimulatingtheSocialbehavior–PSOalgorithm–Topology– Parameter Selection and Improvements for Convergence – Maximum Velocity – Acceleration Constants-Constriction factor -Inertiaweight–Advantagesof PSO.

ANT COLONY OpTIMIZATION(ACO)

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

Text Book(s):

1. S.N. Sivanandam, S.N.Deepa,"Principlesof SoftComputing"2nd Edition, Wiley, 2011.
2. FakhreddineO.KarrayandClarenceDeSilva,"SoftComputing&IntelligentSystem: Theory, Tools and Applications",First edition, Pearson Education, 2009.

Reference(s):

1. KalyanmoyDeb, "Multi-Objective Optimization using EvolutionaryAlgorithms", 3rd Edition,John Wiley&Sons, 2008.
2. ThomasBack,DavidBFogelandZbigniewMichalewicz,"EvolutionaryComputation1 &2 :Basic/advanced Algorithms and Operators",Instituteof Physics Publishing, 2000.
3. Marco Dorigoand Thomas Stutzle, "AntColonyOptimization",MIT Press, 2004.
4. JurgenBranke,KalyanmoyDeb,KaisaMiettinenandRomanSlowinski(Eds.), "MultiObjectiveOptimization:InteractiveandEvolutionary Approaches",Springer- Verlag, 2008.

EEE18RS021	OpTIMIZATIONTECHNIQUES	L	T	p	C
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INTRODUCTION
Definition,Classificationofoptimizationproblems,ClassicalOptimizationTechniques,Single andMultipleOptimization with and withoutinequalityconstraints.

LINEAR pROGRAMMING(Lp)
Simplex method of solving LPP, revised simplex method, duality, constrainedoptimization,Theoremsandprocedure,Linearprogramming,mathematicalmodel, solution technique, duality.

NON LINEARpROGRAMMING
Steepestdescentmethod,conjugatesgradientmethod,NewtonsMethod,Sequentialquadratic programming, Penaltyfunction method, augmentedLagrangemultipliermethod.,

DYNAMIC pROGRAMMING(Dp)
Multistage decisionprocesses, concept of sub-optimization and principle of optimality, Recursive relations,IntegerLinear programming, Branchand bound algorithm

GENETIC ALGORITHM
IntroductiontogeneticAlgorithm,workingprinciple,codingofvariables,fitnessfunction,GA operators; Similaritiesand differencesbetweenGasandtraditionalmethods;Unconstrained and constrainedoptimization using geneticAlgorithm,realcodedgas,Advanced Gas,global optimization usingGA,Applications to power system.

Reference(s):
1. Computational methodsin Optimization,Polak,AcademicPress, 1971.
2. Optimization Theory with applications,PierreD.A.,WileyPublications,1969.
3. Taha, R. A., OperationsResearch: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi,2002.
4. S.S.Rao,"Optimization–TheoryandApplications",Wiley-EasternLimited,1984.
5. G.Luenberger,"Introduction ofLinear and Non-Linear Programming",Wesley PublishingCompany, 2011

CSE18RS0S1	CLOUDCOMpUTING	L	T	p	C
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Unit-1

IntroductionCloudComputing:Nutshellofcloudcomputing,EnablingTechnology,Ristorical development,Vision,feature Characteristicsandcomponentsof CloudComputing.Challenges, RisksandApproachesofMigrationintoCloud.EthicalIssueinCloudComputing,Evaluating the Cloud's BusinessImpactandeconomics,Futureofthecloud.NetworkingSupportforCloud Computing. Ubiquitous Cloud and theInternet ofThings

Unit-2

CloudComputingArchitecture:CloudReferenceModel,LayerandTypesofClouds,Services models,Datacenter Designandinterconnection Network,Architectural designof Computeand StorageClouds.CloudProgrammingandSoftware:Fracturesofcloudprogramming,Parallel anddistributedprogramming paradigms-MapReduce,Radoop,RighlevelLanguageforCloud. ProgrammingofGoogleApp engine,

Unit-3

Virtualization Technology:Definition, Understanding and Benefits of Virtualization. ImplementationLevelof Virtualization,VirtualizationStructurelToolsandMechanisms, RypervisorVMware,KVM,Xen.Virtualization:of CPU, Memory,IlODevices,VirtualCluster andResourcesManagement,Virtualizationof Server,Desktop,Network,andVirtualizationof data-center

Unit-4

SecuringtheCloud:CloudInformationsecurityfundamentals,Cloudsecurityservices,Design principles,Policy Implementation,CloudComputingSecurity Challenges,CloudComputingSecurity Architecture. Legal issues in cloud Computing. DataSecurity inCloud:BusinessContinuityandDisasterRecovery,RiskMitigation, Understanding andIdentificationofThreatsinCloud,SLA-ServiceLevelAgreements,Trust Management

Unit-S

Cloud Platforms inIndustry: Amazon web services GoogleAppEngine,Microsoft Azure Design, Aneka CloudApplication Platform-Integrationof Private and Public CloudsCloudapplications: Proteinstructure prediction,DataAnalysis, SatelliteImage Processing,CRMandE,Social networking .CloudApplication-ScientificApplication,BusinessApplication.AdvanceTopicin Cloud Computing: Federated CloudlInterCloud, Third PartyCloud Services.

Text/ReferenceBooks :

1. "DistributedandCloudComputing"ByKaiHawang,GeofreyC.Fox,Jack Dongarra Pub: Elservier
2. CloudComputing,PrincipalandParadigms,EditedByRajkumarBuyya, JemesBroberg, Goscinski, Pub.-Wiley
3. Kumar Saurabh,"CloudComputing",WileyPub
4. Krutz, Vines, "CloudSecurity", WileyPub
5. Velte, "Cloud Computing-A Practical Approach",TMH Pub

CSE18RS0S2	IOTAND AppLICATIONS	L	T	p	C
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Unit 1

IoT&WebTechnologyTheInternetofThingsToday,TimeforConvergence,TowardstheIoT Universe,Internetof ThingsVision,IoTStrategic ResearchandInnovationDirections,IoT Applications, FutureInternet Technologies,Infrastructure, Networksand Communication, Processes, Data Management, Security, Privacy &Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Unit 2

M2MtoIoT–ABasicPerspective–Introduction,SomeDefinitions,M2MValueChains,IoT ValueChains,Anemerging industrialstructureforIoT,Theinternationaldrivenglobalvalue chainandglobalinformationmonopolies. M2MtoIoT-AnArchitecturalOverview–Buildingan architecture,Maindesignprinciplesandneededcapabilities,AnIoTarchitecture outline, standards considerations.

Unit 3

IoTArchitecture-StateoftheArt–Introduction,Stateoftheart,ArchitectureReferenceModel-Introduction,ReferenceModeland architecture,IoTreference Model,IoTReference Architecture-Introduction, FunctionalView,Information View,Deployment and Operational View, OtherRelevant architectural views

Unit 4

IoTApplicationsforValueCreationsIntroduction,IoTapplicationsforindustry:FutureFactory Concepts,BrownfieldIoT, SmartObjects,SmartApplications,Four Aspectsinyour Businessto MasterIoT, ValueCreationfromBig DataandSerialization,IoTforRetailingIndustry,IoTFor Oiland GasIndustry,OpinionsonIoT Application and ValueforIndustry,RomeManagement, eRealth.

Unit S

InternetofThingsPrivacy,SecurityandGovernanceIntroduction,OverviewofGovernance, Privacy andSecurityIssues,ContributionfromFP7Projects,Security,Privacy andTrustinIoT- Data-Platformsfor SmartCities,FirstStepsTowardsa Secure Platform,SmartieApproach. Data Aggregation for theIoTin Smart Cities, Security

RefereneeBooks:

1. VijayMadisettiandArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014

2.FrancisdaCosta,"RethinkingtheInternetofThings:AScalableApproachtoConnecting Everything",1 st Edition, ApressPublications, 2013

3.CunoPfister,Getting StartedwiththeInternetofThings,O(ReillyMedia,2011,ISBN:978-1-4493-9357-1

CSE18RS0S3	BIGDATA ANALYTICS	L	T	p	C
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INTRODUCTION TO DATA ANALYTICS

Dataanalyticsprocess–roles,stagesindatascienceproject–workingwithdatafrom files–working-withrelationaldatabases–exploringdata–managingdata–cleaning and samplingfor modelingand validation–introduction to NoSQL.

MODELINGMETHODS

Choosingandevaluatingmodels–mappingproblemstomachinelearning,evaluating clusteringmodels,validatingmodels– clusteranalysis– K-meansalgorithm,Naive Bayes – Memorization Methods –Linear and logistic regression –unsupervised methods.

INTRODUCTION TO R

ReadingandgettingdataintoR–orderedandunorderedfactors–arraysandmatrices– listsanddataframes–readingdatafromfiles–probabilitydistributions– statistical models in R-manipulatingobjects–data distribution.

MApREDUCE

Introduction–distributedfilesystem–algorithmsusingmapreduce,Matrix-Vector Multiplicationby MapReduce–Radoop-UnderstandingtheMapReducearchitecture-Writing RadoopMapReducePrograms-Loadingdatainto RDFS-Executing the Map phase-Shufflingand sorting -Reducingphase execution.

DELIVERINGRESULTS

Documentationanddeployment–producingeffectivepresentations–Introductionto graphical analysis –plot() function –displaying multivariate data –matrix plots – multiple plots in one window - exporting graph - using graphics parameters. Case studies.

Referenees:

1. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.
2. Jure Leskovec, AnandRajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets",CambridgeUniversityPress, 2014.
3. 3.MarkGardener,"BeginningR-TheStatisticalProgrammingLanguage",John Wiley&Sons,Inc., 2012.
4. W.N.Venables,D.M.SmithandtheRCoreTeam,"AnIntroductiontoR", 2013.
5. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, AbhijitDasgupta, "PracticalData ScienceCookbook", PacktPublishing Ltd., 2014.
6. NathanYau,"VisualizeThis:TheFlowingDataGuidetoDesign,Visualization, andStatistics",Wiley, 2011.
7. Boris lublinsky, Kevin t. Smith, AlexeyYakubovich, "Professional Hadoop Solutions",Wiley,ISBN: 9788126551071, 2015.
8. http:llwww.johndcook.comlR_language_for_programmers.html

9.http:llbigdatauniversity.com