Department of Mechanical Engineering
V.B.S.Purvanchal University, Jaunpur

STUDY&EVALUATIONSCHEMEWITHSYLLABUS

FOR

B.TECH.3rdYEAR

MECHANICALENGINEERING

[EffectivefromSession:2020-21]

SyllabusContentofB.TechMechanicalEngineering

B.TechMechanicalEngineering Evaluation Scheme

SEMESTER-V													
Sl. No.	**Code**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credits**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KME501	HeatandMassTransfer	3	1	0	30	20	50		100		150	4
2	KME502	StrengthofMaterial	3	1	0	30	20	50		100		150	4
3	KME503	IndustrialEngineering	3	1	0	30	20	50		100		150	4
4		DepartmentalElective-I	3	0	0	30	20	50		100		150	3
5		DepartmentalElective-II	3	0	0	30	20	50		100		150	3
6	KME551	HeatTransferLAB	0	0	2				25		25	50	1
7	KME552	PythonLab	0	0	2				25		25	50	1
8	KME553	InternetofThingsLab	0	0	2				25		25	50	1
9	KME554	MiniProjectorInternship Assessment*	0	0	2				50			50	1
10	KNC501/ KNC502	Constitution of India, Lawand Engineering / Indian Tradition,CultureandSociety	2	0	0	15	10	25		50			NC
11	MOOCs(EssentialforHons.Degree)												
		Total	**17**	**3**	**6**							**950**	**22**

***TheMiniProjectorinternship(4-5weeks)conducteddduringsummerbreakafterIVsemesterandwill be assessed during V semester.

SEMESTER-VI													
Sl. No.	**Code**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credits**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KME601	RefrigerationandAir Conditioning	3	1	0	30	20	50		100		150	4
2	KME602	Machine Design	3	1	0	30	20	50		100		150	4
3	KME603	TheoryofMachine	3	1	0	30	20	50		100		150	4
4		DepartmentalElective-III	3	0	0	30	20	50		100		150	3
5		OpenElective-I	3	0	0	30	20	50		100		150	3
6	KME651	RefrigerationandAir Conditioning Lab	0	0	2				25		25	50	1
7	KME652	MachineDesignLab	0	0	2				25		25	50	1
8	KME653	TheoryofMachineLab	0	0	2				25		25	50	1
9	KNC601/ KNC602	ConstitutionofIndia, Lawand Engineering/IndianTradition, Culture and Society	2	0	0	15	10	25		50			NC
10	**Total**		**17**	**3**	**6**							**900**	**21**

ItissuggestedthatthestudentsshouldchooseDepartmentalElectivesSpecialization wisethatwill support them to gain enough learning of the chosen Specialization.

DepartmentElectives

	Specialization-1	**Specialization-2**	**Specialization-3**	**Specialization-4**	**Specialization-5**
Specialization	**Manufacturing andAutomation**	**Automationand Industry 4.0**	**Designand Analysis**	**Thermal Engineering**	**Automobile Engineering**
SemVCode	KME051	KME052	KME053	KME054	KAU051
Departmental Elective-I	Computer Integrated Manufacturing	Mechatronics Systems	FiniteElement Methods	I C Engine Fuel andLubrication	Automobile Engines & Combustion
SemVCode	KME055	KME056	KME057	KME058	KAU052
Departmental Elective-II	Advancewelding	Programming, Data Structures AndAlgorithms Using Python	Mechanical Vibrations	Fuels and Combustion	Automotive chassisand suspension
SemVICode	KME061	KME062	KME063	KME064	KAU061
Departmental Elective-III	Nondestructive Testing	Artificial Intelligence	Tribology	GasDynamics and Jet Propulsion	Automotive Electricaland Electronics
SemVIICode	KME071			KME072	KAU072
Departmental Elective-IV	Additive manufacturing (CommontoallThreeSpecializations)			HVAC systems	HybridVehicle Propulsion
SemVIICode	KME073	KME074	KME075	KME076	KAU073
Departmental Elective-V	Mathematical Modeling of Manufacturing Processes	Machine Learning	Computer Graphicsand product modeling	PowerPlant Engineering	Vehicle Body Engineering& safety

It is suggested that the students may also do the following MOOCs in addition to mandatory courses. This will enhance their learning in a particular Specialization. One MOOC per semester is recommended.

SuggestedMOOCs Course

Specialization	Specialization-1	Specialization-2	Specialization-3	Specialization-4	Specialization-5
	Manufacturingand Automation	**Automationand Industry 4.0**	**Designand Analysis**	**ThermalEngineering**	**Automobile Engineering**
SemV	**AdvanceMachining Process** https://swayam.gov.in/nd1_noc20_me76/preview ByProf.ManasDas, IIT Guwahati	**ControlSystems** https://swayam.gov.in/nd1_noc20_ee90/preview ByProf.C.S.Shankar Ram,IIT Madras	**Experimental StressAnalysis** https://swayam.gov.in/nd1_noc20_me02/preview By Prof. K. Ramesh IITMadras	**Fluiddynamicsand turbo machines** https://swayam.gov.in/nd1_noc20_me75/preview By Prof.Dhiman Chatterjee,Prof.Shamit Bakshi,IIT Madras	**VehicleDynamics** https://nptel.ac.in/courses/107/106/107106080/ Prof P R Krishnakumar,IIT Madras
Sem VI	**Introduction to robotics**https://swayam.gov.in/nd1_noc20_de11/previewBy Prof. Asokan T, Prof. BalaramanRavindran, Prof. KrishnaVasudevan, IIT Madras	**Introductionto robotics** https://swayam.gov.in/nd1_noc20_de11/preview By Prof. Asokan T, Prof. BalaramanRavindran, Prof. KrishnaVasudevan,	**Introductionto CFD** https://swayam.gov.in/nd1_noc20_ae11/previewByProf.Arnab Roy,IITKharagpur	**IntroductiontoCFD** https://swayam.gov.in/nd1_noc20_ae11/preview ByProf.ArnabRoy,IIT Kharagpur	**Control Systems**https://swayam.gov.in/nd1_noc20_ee90/preview By Prof. C. S. ShankarRam,IIT Madras
Sem VII	**Automation in Manufacturing** https://swayam.gov.in/nd1_noc20_me58/preview ByProf.Shrikrishna N.Joshi,IIT Guwahati	**Introduction to Industry 4.0 and IndustrialInternetof Things** https://swayam.gov.in/nd1_noc20_cs69/preview ByProf.SudipMisra, IITKharagpur	**Introduction to Composites** https://swayam.gov.in/nd1_noc20_me95/preview ByProf.Nachiketa Tiwari,IITKanpur	**Fundamentals of CompressibleFlow** https://swayam.gov.in/explorer?searchText=Compressible%20Flow ByProf.NiranjanSahoo, IIT Guwahati	**Introduction to hybridandElectric Vehicles** MOOC: https://nptel.ac.in/courses/108/103/108103009/ Dr.PraveenKumar, Prof. S. Majhi, IIT Guwahati
Sem VIII	**Production and Operation Management** https://swayam.gov.in/nd1_noc20_mg06/preview ByProf.Rajat Agrawal, IIT Roorkee	**Supply Chain management** https://swayam.gov.in/nd2_cec20_mg11/preview ByDr.P.Chitramani, AvinashilingamInstitute for Home Science and Higher Education for Women	**Material Characterization**https://swayam.gov.in/nd1_noc20_mm14/previewBy Prof.Sankaran. S, IIT Madras	**Computational Fluid Dynamics for IncompressibleFlows** https://swayam.gov.in/nd1_noc20_me06/preview ByProf.AmareshDalal, IIT Guwahati	**Fuel CellTechnology** https://nptel.ac.in/courses/103/102/103102015/ ByDr.AnilVerma, IITGuwahati &Prof.S.Basu,IIT Delhi

SubjectCode:KME 501	HeatandMass Transfer	L TP:3 1 0	Credits:4

Thestudentswillbeableto		Blooms Taxonomy
CO-1	Understandthe fundamentalsofheatandmasstransfer.	K2
CO-2	Applytheconceptofsteadyandtransientheatconduction.	K3
CO-3	Applytheconceptofthermalbehaviorof fins.	K3
CO-4	Applytheconceptofforcedandfree convection.	K3
CO-5	Applytheconceptofradiationforblackandnon-blackbodies.	K3
CO-6	Conductthermalanalysisofheatexchangers.	K4

UNIT-1

IntroductiontoHeatTransfer (L-5Hours)

Introduction of thermodynamics and Heat Transfer, Modes of Heat Transfer: Conduction, convectionandradiation,Effectoftemperatureonthermalconductivityofdifferenttypesofmaterials,Introduction to combinedheat transfer mechanism, Generaldifferential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems, Initial and system boundary conditions.

Steady State one-dimensional Heat conduction (L-3 Hours)

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and withoutenergy generation, Concept of thermal resistance, Analogy between heat and electricity flow, Thermal contact resistance and over-all heat transfer coefficient, Critical radius of insulation for cylindrical, and spherical bodies.

UNIT-2

Fins (L-3Hours)

Heat transfer through extended surfaces and its classification, Fins of uniform cross-sectional area, Error in measurement of temperature of thermometer wells.

TransientConduction (L-3Hours)

Transientheatconduction,Lumpedcapacitancemethod,Timeconstant,Unsteadystateheatconduction in one dimension only, Heisler charts and their applications.

UNIT-3

ForcedConvection (L-5Hours)

Basic concepts: Hydrodynamic boundary layer, Thermal boundary layer, Approximate integral boundary layer analysis, Analogy between momentum and heat transfer in turbulent flow over a flat surface,Mixed boundary layer, Flow over a flat plate, Flow across a single cylinder and a sphere, Flow inside ducts, Thermal entrance region, Empirical heat transfer relations, Relation between fluid friction and heat transfer, Liquid metal heat transfer.

Natural Convection (L-5Hours)

Physicalmechanismofnaturalconvection,Buoyantforce,Empiricalheattransferrelationsfornatural

convection over verticalplanes and cylinders, horizontal plates, cylinders and sphere, combinedfree and forced convection, Effect of turbulence.

UNIT-4

ThermalRadiation (L-8Hours)

Basic concepts of radiation, Radiation properties of surfaces, Black body radiation Planck's law, Wein's displacement law, Stefan-Boltzmann law, Kirchhoff'slaw,Gray body, Shape factor, Black-body radiation, Radiation exchange between diffuse non-black bodies in an enclosure, Radiation shields, Radiation combinedwithconductionandconvection;Absorptionandemissioningaseousmedium;Solarradiation; Greenhouse effect, Radiation network analysis.

UNIT-5

HeatExchanger (L-5Hours)

Different types of heat exchangers, Fouling factors, Overall heat transfer coefficient, Logarithmic mean temperature difference (LMTD) method, Effectiveness-number of transfer unit (NTU) method and Compact Heat Exchangers.

CondensationandBoiling (L-3Hours)

Introduction of condensation phenomena, Heat transfer relations for laminar film condensation on verticalsurfacesand onoutside&inside of ahorizontal tube,Effectof non-condensable gases,Drop wise condensation, Heat pipes, Boiling modes, pool boiling, Hysteresis in boiling curve, Forced convection boiling.

IntroductiontoMassTransfer (L-2Hours)

Introduction of Fick's law of diffusion, Steady state equimolar counter diffusion, Steady state diffusion through a stagnant gas film, Heat and Mass Transfer Analogy -Convective Mass Transfer Correlations

Reference Books:-

1. FundamentalsofHeatandMassTransfer,byIncroperra&DeWitt,JohnWileyandSons
2. HeatandMassTransferbyCengel,McGraw-Hill
3. HeatTransferbyJ.P.Holman,McGraw-Hill
4. HeatandMassTransferbyRudramoorthyandMayilsamy,Pearson Education
5. HeatTransferbyGhoshdastidar,OxfordUniversityPress
6. Atextbook onHeatTransfer,bySukhatme,UniversityPress.
7. HeatTransferbyVenkateshan,AneBooksPvtLtd
8. Schaum'soutlineofHeatTransferbyPitts&Sisson McGraw-Hill
9. HeatandMassTransferbyRYadav,CentralPublishing House

SubjectCode:KME 502	Strengthof Material	L TP:3 1 0	Credits:4

CourseOutcomes:Thestudentwillbeableto		Blooms Taxonomy
CO1	Understandtheconceptofstressandstrainunderdifferentconditionsofloading	K2
CO2	Determinethe principalstressesandstrainsinstructuralmembers	K3
CO3	Determinethestressesandstrainsinthememberssubjectedtoaxial,bendingand torsionalloads	K3
CO4	Applytheconceptsofstressesandstraininsolvingproblemsrelatedtosprings, columnandpressure vessels	K3
CO5	Calculatetheslope,deflectionandbucklingofloaded members	K3
CO6	Analyzethestressesdevelopedinstraightandcurvedbeamsofdifferentcross sections	K4

UnitI **8Hours**

Compound stress andstrains: Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's circle for plane stress, three dimensional states of stress & strain, equilibrium equations, generalized Hook's law, theories of failure. Thermal Stresses.

UnitII **8Hours**

Stresses in Beams: Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Differential equation of the elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams

Torsion: Torsion,combinedbending&torsionofsolid&hollowshafts,torsionofthinwalledtubes.

UnitIII **8Hours**

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columnsin mechanical equipment and machines.

UnitIV **8Hours**

Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

UnitV **8Hours**

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

TextBooks:

1. StrengthofmaterialsbySadhuSingh,KhannaBookPublishingCo.(P)Ltd.
2. StrengthofMaterialbyRattan,MCGRAWHILL INDIA
3. MechanicsofMaterialsbyB.C.Punmia,LaxmiPublications(P)Ltd.

Reference Books:

1. MechanicsofMaterialsby Hibbeler, Pearson.
2. MechanicsofmaterialbyGere,CengageLearning
3. MechanicsofMaterialsbyBeer,Jhonston,DEwolfandMazurek,MCGRAWHILL INDIA
4. StrengthofMaterialsbyPytelandSinger,HarperCollins
5. StrengthofMaterialsbyRyder, Macmillan.
6. StrengthofMaterialsbyTimoshenkoandYσungs,EastWestPress.
7. IntroductiontoSolidMechanicsbyShames,Pearson
8. MechanicsofmaterialbyPytel,Cengage Learning
9. AnIntroductiontoMechanicsofSolidsbyCrandall,MCGRAWHILL INDIA
10. StrengthofMaterialsbyJindal,PearsonEducation
11. StrengthofMaterialsbyBasavajaiahandMahadevappa,University Press.

SubjectCode:KME 503	IndustrialEngineering	L TP:3 1 0	Credits:4

CourseOutcomes:Thestudentswillbeableto		Blooms Taxonomy
CO1	Understand theconcept of productionsystem, productivity,facility and process planning in various industries	K2
CO2	Applythevariousforecastingandprojectmanagement techniques	K3
CO3	Applytheconceptofbreak-evenanalysis,inventorycontrolandresource utilizationusingqueuingtheory	K3
CO4	Applyprinciplesofworkstudyandergonomicsfordesignofwork systems	K3
CO5	Formulatemathematicalmodelsforoptimalsolutionofindustrialproblemsusing linearprogrammingapproach	K4

Unit-I:

Overview of Industrial Engineering: Types of production systems, concept of productivity, productivity measurement in manufacturing and service organizations, operations strategies, liability and process design.

Facility location and layout: Factors affecting facility location; principle of plant layout design, types of plant layout; computer aided layout design techniques; assembly line balancing; materials handling principles, types of material handling systems, methods of process planning, steps in process selection, production equipment and tooling selection, group technology, and flexible manufacturing.

UnitII:

Production Planning and control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; materials requirement planning (MRP) and MRP-II; routing, scheduling and priority dispatching, concept of JIT manufacturing system

ProjectManagement: Projectnetworkanalysis,CPM,PERTandProjectcrashing.

UnitIII:

Engineering economy and Inventory control: Methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements, time-cost trade-off, resource levelling; Inventory functions, costs, classifications, deterministic inventory models, perpetual and periodic inventory control systems, ABC analysis, and VED analysis.

Queuing Theory: Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Classification of Queuing models.

UnitIV

Work System Design: Taylor's scientific management, Gilbreths's contributions; work study: method study,micro-motionstudy,principlesofmotioneconomy;workmeasurement–timestudy,work

sampling, standard data, Predetermined motion time system (PMTS); ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

Product Design and Development: Principles of product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, and concurrent engineering.

UnitV:

Operational Analysis: Formulation of LPP, Graphical solution of LPP, Simplex Method, Sensitivity Analysis,degeneracyand unbound solutions.transportation and assignment models;Optimality test: the stepping stone method and MODI method, simulation.

BooksandReferences:

1. IndustrialEngineeringandProductionManagementbyMartandTTelsangS.Chand Publishing
2. IndustrialEngineeringandProductionManagementbyM.MahajanDhanpatRai&Co.(P)Limited
3. IndustrialEngineeringandManagementbyRaviShankar,GalgotiaPublicationsPvtLtd
4. ProductionandOperationsManagementbyAdam,B.E.&Ebert,R.J.,PHI
5. ProductDesignandManufacturingbyChitaleA.V.andGuptaR.C.,PHI
6. OperationsResearchTheory&ApplicationsbyJKSharma,MacmillanIndiaLtd,
7. ProductionSystemsAnalysisandControlbyJ.L.Riggs,JohnWiley&Sons
8. Automation,ProductionSystems&ComputerIntegratedManufacturingbyGroover,M.P.PHI
9. OperationsResearch,byA.M.Natarajan,P.Balasubramani,A.Tamilarasi,Pearson Education
10. OperationsResearchbyP.K.Gupta andD.S.Hira,S.Chand &Co.

SubjectCode:KME 551	HeatandMass TransferLab	L TP:0 0 2	Credits:1

Thestudentswillbeableto		Blooms Taxonomy
CO1	Applytheconceptofconductiveheattransfer.	K3
CO2	Applyempiricalcorrelationsforbothforcedandfreeconvectiontodetermine thevalue ofconvectionheattransfer coefficient	K3
CO3	Applytheconceptofradiationheattransferfor blackandgreybody.	K3
CO4	Analyzethe thermalbehaviourofparallelorcounterflowheatexchangers	K4
CO5	Conductthermalanalysisofaheatpipe	K4

ListofExperiments

Minimumeightexperimentofthefollowing

1. Todeterminethermalconductivityofconductivematerial(s).
2. Todeterminethermalconductivityofinsulatingmaterial(s).
3. Todetermineheatconductionthroughlaggedpipe.
4. Todetermineheattransferthroughfinundernaturalconvection.
5. TodeterminetheheattransferRateandTemperatureDistributionforaPinFin.
6. Determinationofthermalconductivityofdifferenttypesoffluids.
7. ExperimentonStefan'sLaw-determinationofemissivity, etc.
8. Experimentonconvectiveheattransferthroughflatplatesolarcollector.
9. TocompareLMTDandEffectivenessofParallelandCounterFlowHeatExchangers.
10. TofindtheheattransfercoefficientforForcedConvectioninatube.
11. TofindtheheattransfercoefficientforFreeConvectionina tube.
12. Toconduct experimentsonheat pipe.
13. Tostudythe ratesofheattransferfordifferentmaterialsandgeometries.
14. VisittoaThermalPowerStationforpractical exposure.

SubjectCode:KME 552	PythonLab	L TP:0 0 2	Credits:1

Courseoutcomes:Thestudentswillbeableto		Blooms Taxonomy
CO1	Applyconditionalstatement,loopsconditionandfunctionsinpython program	K3
CO2	Solvemathematicalandmechanicalproblemsusingpython program	K3
CO3	Plotvarioustypeofchartusingpython program	K3
CO4	Analyzethemechanicalproblemusingpythonprogram	**K4**

ListofPython Program

1. Writeaprogramtofindrootofquadratic equation
2. Writeaprogramtofindanddeleterepeatingnumberin GivenList
3. Writeaprogramtoinputandprinttheelementsumofuserdefinedmatrix
4. Writeaprogramtoinputandmultiplytwodifferentmatrices
5. Writeaprogramtocomputeeigenvalueandvectorofagiven3*3matrixusingNumPy
6. Writeaprogramtofindasolutionoflinearequationsiny-mx+c
7. Writeaprogramtodrawlineusingequation y=mx+c
8. Writetheprogramtodeterminetheintersectionpointoftwo line.
9. Drawvarioustypesofchartsusing matplotlib
10. Writeaprogramtoperformequationsofuniformmotionofkinematics:

i. v= u+ at0
ii. s= ut+ ½(at^2)
iii. v^2= u^2– 2as

11. Writeamenudrivenprogramtoperformfollowingpropertiesofthermodynamicsasgiven below:

i. First Law of thermodynamics (U = Q - W), where ΔU is the change in the internal energy. Q is the heat added to the system, and W is the work done by the system.
ii. EfficiencyofHeatEngine=TH–TC/THwhereTH&TCisthetemperatureofHOTandCOLD Reservoirs.

12. Writethemenuprogramtofindthetofindtheoutrelationshipbetweenstressandstrain curve as given below:

i. Young'sModulus
ii. Shear Modulus
iii. PoissonRatio

13. Writetheprogramtodeterminetheshearforceandbendingmomentin beams.
14. Writeaprogramtofindmaxima/minimaoffunctionsoftwovariablesandevaluatesomereal definite and finite integrals.
15. WriteaProgramtofindoutunknownmagnitudeofTBandTDofunknowntensioncanbe obtained from two scalar equations of equilibrium i.eEF_x = 0 and EF_y =0.
16. Writeaprogramtoperforminterpolationofequallyandunequallyspaceddata.
17. Writeaprogramtocalculatetotalpressureexertedinidealfluidasequationisgivenbelow: p+1/2(ρv^2) + ρgh =constant

WherePisPressure,VisVelocity offluid,pisdensityandhistheheightofthecontainer.

18. WriteaprogramtofindnumericaldifferentiationusingFinitedifferencesMethodby importing NumPy and plot the numerical values using matplotlib libraries of python.
19. Writeaprogramforbresenham'slinedrawingalgorithm.
20. Writeaprogramforgeometrictransformationofagivenobject.

SubjectCode:KME 553	InternetofThings Lab	L TP:0 0 2	Credits:1

ProposedByMIET

Thestudentswillbeableto		Blooms Taxonomy
CO1	UnderstandInternetofThingsanditshardwareandsoftwarecomponents	K2
CO2	InterfaceI/Odevices,sensors&communication modules	K3
CO3	Remotelymonitordataandcontroldevices	K3
CO4	DesignprototypeofIoTbasedsmartsystem	K4
CO5	DevelopIoT basedprojectsfor reallife problem	K6

ListofExperiments:

S.No.	NameofExperiment	Outcome
1	Familiarization with concept of IoT, Arduino/RaspberryPiandperformnecessary software installation.	Will be able to understand IoT, Arduino/RaspberryPi,andalsoableto install software setup of Arduino/ Respberry Pi
2	To interface motor using relay with Arduino/RaspberryPiandwriteaprogramtoturn ON/OFF motor.	Abletouserelaytocontrolmotorand other mechanical devices
3	Tointerfacesensors*withArduino/RaspberryPi andwriteaprogramtodisplaysensorsdataonthe computer screen.	Abletoretrievedatafromsensorsandto display it on computer screen
4	Tointerface OLEDwithArduino/RaspberryPiand writeaprogramtodisplaysensordataonit.	Abletoretrievedatafromsensorsandto displayitonOLED
5	TointerfacesensorwithArduino/RaspberryPiand writeaprogramtoturnON/OFFRelaywhen sensor data is detected.	Abletocontrolrelaywithhelpof microcontroller and sensors
6	TointerfacesensorwithArduino/RaspberryPiand write a program to turn ON/OFF Solenoid valve when sensor data is detected.	AbletocontrolSolenoidvalvewithhelpof microcontroller and sensors
7	TointerfacesensorwithArduino/RaspberryPiand write a program to turn ON/OFF Linear Actuator whensensordatais detected.	Abletocontrollinearactuatorwithhelpof microcontroller and sensors
8	TointerfacesensorwithArduino/RaspberryPiand write a program to turn ON/OFF Starter Motor whensensordatais detected.	AbletocontrolStarterMotorwithhelpof microcontroller and sensors
9	TointerfaceBluetoothwithArduino/RaspberryPi andwriteaprogramtosendsensor datato smart phoneusingBluetooth.	Abletocommunicatesensordatafrom microcontroller to smart phone
10	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn Actuators* ON/OFF whenmessageisreceivedfromsmartphoneusing Bluetooth.	Abletocontrolactuatorsusingmobile phone through Bluetoth
11	WriteaprogramonArduino/RaspberryPito	Abletouploadstatusofdevicesand

	uploadSensordatatothingspeakcloud.	sensorsonwebcloud
12	WriteaprogramonArduino/RaspberryPito retrievesensorsdatafromthingspeak cloud.	Abletoretrievestatusofdevicesand sensors from web cloud
13	DevelopIoTbasedsmartlocksystemforMotor cycle/Car	Abletodevelopsmartlocksystemofmotor cycle/car
14	DevelopIoT basedSmartwaterflow system	Abletodevelopsmartwaterflowsystem
15.	DevelopIoT basedhomesecuritysystem	Abletodevelopsmarthomesecurity system

Componentsrequired-

1. Arduinowithcable
2. RaspberryPiwithcableandmemorycard
3. NodeMCU
4. *Sensors-IR,LDR,DHT11sensor,Pushbutton,Pressuresenser,Temperaturesensor,Vibration, Rotation, Location, Torque, Sound, Weight etc.
5. *Actuators-LED,Buzzer,RelaySwitch,Motors,MotorDrivers,OLED,Display,LinearActuator, Solenoid Valve, Starter Motor etc.
6. BluetoothModule,Wi-fiModule,EthernetModule
7. Smart Phone
8. Computer
9. PowerSupply-5V,12V,3.3V
10. Internetfacility

Semester–V:DepartmentalElective–I:Specialization–ManufacturingandAutomation

SubjectCode:KME051	ComputerIntegratedManufacturing	L TP:3 0 0	Credits:3

CourseOutcome:Studentwillbeableto		Bloom Taxonomy
CO1	Understandthebasicconceptsofautomation,computernumericcontrol machining	K2
CO2	Understandthealgorithmsoflinegeneration,circlegeneration, transformation, curve,surfacemodelingandsolidmodeling	K2
CO3	Understandgrouptechnology,computeraidedprocessplanning, flexible manufacturing,Industry4.0,robotics	K2
CO4	Understandinformationsystemandmaterialhandlinginenvironment,rapid prototyping	K2
CO5	Applythealgorithmsofline&circlegenerationandgeometric transformations	K3
CO6	DevelopCNCprogramforsimpleoperations	K3

Unit1

Introductionto Computer IntegratedManufacturing (CIM): Introduction toCAD, CAM, CIM, Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. Computer Integrated Manufacturing, Computers in manufacturing industries.

Unit2

PrinciplesofComputerGraphics:

Pointplotting,drawingoflines,Bresenham'scirclealgorithm.

TransformationinGraphics:

2Dtransformations–rotation,scaling,translation,mirror,reflection,shear–homogeneous transformations – concatenation, 3D transformations.

Curves: IntroductiontoHermitecubicsplines,Beziercurves,B-splinecurves,NURBS

SurfaceModeling: Polygonsurfaces,Quadricsurfaces,Superquadricsurfacesandblobbyobjects

Solidmodeling: Booleansetoperations,Primitiveinstancing,Sweeprepresentation,Boundadry representation, Constructive solid geometry,

Unit3

ComputerAidedManufacturing:

NC in CAM – Principal types of CNC machine tools and their construction features–toolingforCNC–ISOdesignationfortooling–CNCoperatingsystem
Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming.

Unit4

GroupTechnology: Grouptechnology,CellularManufacturing,CAPP–VariantandGenerativesystems-

ConcurrentEngineeringandDesignforManufacturing.
Flexible Manufacturing System: characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects, Industry 4.0.

Robotics: Classification and specification – drive and controls – sensors - end effectors - grippers-toolhandling and work handling – machine vision – robot programming concepts – case studies in assembly. Introduction to Programmable logical controller

Unit5
DataandinformationinCIM: ManagementinformationsysteminCIMenvironment,MRP–MRPII–ERP -Capacity planning.

Materialhandling in CIMenvironment: Types– AGVS– AS/RS– Swarfhandling and disposal of wastes– single and mixed mode assembly lines – quantitative analysis of assembly systems.

Rapid prototyping: Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.

Booksand References:

1. MikellP.Groover-Automation,Production SystemsandComputerIntegratedManufacturing,Second edition, Prentice Hall of India.
2. IbrahimZeid-CAD/CAMtheoryandPractice,TataMcGrawHillPublishingCo.Ltd.,CompanyLtd., New Delhi.
3. YoramKoren,Controlofmachinetools,McGraw-Hill.
4. Hearn&Baker,ComputerGraphics,PrenticeHallofIndia
5. SunilKumarSrivastava,ComputerAidedDesign:ABasicandMathematicalApproach,IKInternational Publishing House
6. P.Radhakrishnan,-CAD/CAM/CIM,NewAgeInternational(P)Ltd.,NewDelhi

Semester–V:DepartmentalElective– I:Specialization– AutomationandIndustry 4.0

SubjectCode:KME052	MechatronicsSystems	L TP:3 0 0	Credits:3

CourseOutcome:Studentwillbeableto		Bloom Taxonomy
CO1	Identifykeyelementsofmechatronicsanditsrepresentationbyblockdiagram.	K2
CO2	Understandtheconceptofsensorsanduseofinterfacingsystems.	K2
CO3	Understandtheconceptandapplicationsofdifferentactuators	K2
CO4	Illustrate variousapplicationsofmechatronicsystems.	K2
CO5	DevelopPLCladderprogrammingandimplementationinreallife problem.	K5

UnitI:Mechatronics&ItsScope

Mechatronics System: Introduction to Mechatronic Systems, Evolution, Scope, Application Areas, Basic Elements and Control of Mechatronics systems, Advantages and disadvantages of Mechatronics, Industrial applications of Mechatronics, autotronics, bionics, and avionics and their applications

Control System Concepts: Introduction to Control Systems, Elements of control system, Basic of open and closed loop control with example.

UnitII: Sensor&Transducer

Definition and classification of sensor and transducer, performance terminology, static and dynamic characteristics, Principle of working and application of Inductive Proximity, Capacitive Proximity, Photoelectric, Ultrasonic, Magnetic, Hall Effect, Tactile Sensor, load cell, LVDT and interfacing sensors in Mechatronic system.

UNITIII:ACTUATIONSYSTEMS

Fluid Based Actuation: Concept of Hydraulic and Pneumatic Actuation system, Oil and Air preparation unit, Direction Control Valve, Pressure Control Valve, Single and doubly actuated systems, Actuators and Accumulators.

Electrical Actuation Systems: Introduction to Switching devices,Concept of Electro Mechanical Actuation, Solenoids and Solenoid Operated Direction Control Valves, Principle of working of DC and 3 Phase Induction Motor, Stepper motors and Servo Motors with their merits and demerits.

UNITIV:INDUSTRIALCONTROLLERS

Programmable Logic Controllers: Basic Structure, Types and Working Principle, Concept of Scan Cycle and Scan Time, IO's and its Types, Selection Criteria and Applications

Programming Techniques: Ladder diagram –Concept of Contacts and Coil, Latching/ Holding Circuit, Memory Bits, Timers and Counter.

UNITV:MECHATRONICS APPLICATIONS:

Control of conveyor motor, sorting and packaging unit, pick and place robot, coin counter, operations of bottling plant, domestic washing machine, use of PLC for extending and retracting pneumatic pistonsand their different combinations, automatic car park system, engine management system, other applications in manufacturing.

TextBooks:

1. RolfIsennann,"MechatronicsSystems",Springer,2005.
2. W.Bolten,"Mechatronics",PearsonEducation 2003.
3. HMTLtd,"Mechatronics:,TataMcGrawHill 1998.
4. K.P.Ramachandran,G.K.Vijayaraghavan,M.S.Balasundaram,Mechatronics-Integrated Mechanical Electronic Systems, Wiley.

Semester–V:DepartmentalElective–I:Specialization–DesignandAnalysis

SubjectCode:KME053	FiniteElementMethods	L TP:3 0 0	Credits:3

CourseOutcome:Studentwillbeableto		Bloom Taxonomy
CO1	UnderstandthebasicconceptsofFEMandits applications.	K2
CO2	ApplytheprocedureinvolvedtosolveaproblemusingFiniteElementMethods.	K3
CO3	Developtheelementstiffnessmatricesusingdifferent approach.	K3
CO4	Analyze1Dand2Dproblemusingdifferent methods.	K4
CO5	AnalyzethecomplexgeometricproblemsthroughFEMsoftwarepackages.	K4

Unit1

Introduction, exact solution vs approximate solution, principle of FEM, application of FEM, general procedure for finite element analysis, pre-processing, solution, post processing, Stresses andEquilibrium; Boundary Conditions.

Unit2

Strain-Displacement Relations, Stress–strain relations, Effect of temperature, various approximate methods:weightedresidualmethod,variationalorRayleighRitzmethod,Galerkin'smethod,principle of minimum potential energy.

Unit3

Basic element shapes, generalized co-ordinates, polynomials, natural co-ordinates in one-, two- and three-dimensions, Lagrange and Hermite polynomials, Application of Finite Element Methods to elasticity problems and heat conduction Problems.

Unit4

One dimensional problem of finite element model, Coordinates and Shape function, Potential-energy approach, Galerkine approach, Assembly of Global Stiffness Matrix and Load Vector.

Planetrusses:Globalandlocalcoordinatesystemandstresscalculation.
BeamsandFrames:finiteelementformulationandcalculationofShearForceandBending Moment.

Unit5

Two-dimensional problem using Constant Strain Triangles and Four-node Quadrilateral, Problem modelling and Boundary conditions.

Practical consideration in finite element applications, problem solving on a general purpose FEM software package like ANSYS, ABAQUS, NISA etc.

TextBooks:

1. Chandrupatla,T.R.andBelegundu,A.K.,IntroductiontoFiniteElementsinEngineering,Pearson Education, India (2001).
2. Rao,S.S.,Finite elementmethodinengineering,5thEdition,PergamanInt.LibraryofScience,2010.
3. Huebner,K.H.,TheFiniteElementMethodforEngineers,JohnWiley,NewYork (2001).
4. Logan,D.L.,Afirstcourseinthefiniteelementmethod,6thEdition,CengageLearning, 2016.

Semester–V:DepartmentalElective–I:Specialization–ThermalEngineering

SubjectCode:KME054	ICEngine,FuelandLubrication	L TP:3 0 0	Credits:3

CO	Course Outcome	Bloom Taxonomy
CO1	Explaintheworkingprinciple,performanceparametersandtestingofICEngine.	K2
CO2	UnderstandthecombustionphenomenainSIandCIenginesand factors influencingcombustionchamberdesign.	K2
CO3	UnderstandtheessentialsystemsofICengineandlatesttrendsand developments inIC Engines.	K2
CO4	Understandtheeffectofengineemissionsonenvironmentandhumanhealthand methods of reducing it.	K2
CO5	Applytheconceptsofthermodynamicstoairstandardcycleinlc Engines	K3
CO6	AnalyzetheeffectofvariousoperatingparametersonICengineperformance.	K4

Unit-I (9Hours)

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism- Push rod type, Overhead type (SOHC,DOHC). Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.
TestingandPerformance:Performanceparameters,Basicmeasurements,Blowbymeasurement, Testing of SI and CI engines.

Unit–II (7Hours)

Combustion: StagesofCombustioninSI&CIengine,Factorsaffectingcombustion, Flamespeed,Ignition Delay, Abnormal combustion and its control.
Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it.

Unit–III (8Hours)

Carburetion,Mixturerequirements,Carburetorsandfuelinjection systeminSIEngine,MPFI,Scavenging in 2 Stroke engines.

FuelinjectioninCIengines,Requirements,Typesofinjectionsystems,Fuelpumps,Fuelinjectors, Injection timings.

Turbocharging&itstypes-VariableGeometryTurbocharger,WasteGateTurbocharger,Effectof turbocharging on power & emission.

Unit-IV (9Hours)

Engine Emission and Control: Pollutant - Sources and types – Effect on environment and human health - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions - Catalytic converters and Particulate Traps - Selective Catalytic Reduction(SCR) - Diesel Oxidation Catalyst (DOC).

Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.

UNIT-V **(9Hours)**

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Recent trends in IC engine: Lean burn engine, Stratified charge spark ignition engine, Homogeneous charge spark ignition engine, GDI.

TextBooks

1. ACourseinInternationalCombustionEngines,byMathur&Sharma,DhanpatRai&Sons.
2. I.CEngine,byGaneshan,TataMcGrawHillPublishers.

Reference Books

1. I.CEngineAnalysis&PracticebyE.FObert.
2. InternalCombustionEngineFundamentals,byJohnB.Heywood,TataMcgrawHillPublishers.
3. EngineEmission,byB.B.Pundir,Narosa Publication.
4. EngineeringFundamentalsofInternalCombustionEnginesbyW.W.Pulkrabek,PearsonEducation.
5. FundamentalsofInternalCombustionEnginebyGill,Smith,Ziurs,Oxford&IBHPublishingCO.
6. FundamentalsofInternalCombustionEnginesbyH.N.Gupta,PrenticeHallofIndia.

Semester–V:DepartmentalElective–I:Specialization–AutomobileEngineering Proposed By

SubjectCode:KAU051	AutomobileEngines&Combustion	L TP:3 0 0	Credits:3

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CO	Course Outcome	Bloom Taxonomy
CO1	Explaintheworkingprinciple,performanceparametersandtestingofICEngine.	K2
CO2	UnderstandthephenomenaofcombustionanditsapplicationinSIandCI engines.	K2
CO3	UnderstandtheessentialsystemsofIC engine.	K2
CO4	Understandtheeffectofengineemissionsonenvironmentandhumanhealth and methodsof reducingit.	K2
CO5	Applytheconceptsofthermodynamicstoairstandardcycleinic Engines	K3
CO6	AnalyzetheeffectofvariousoperatingparametersonICengineperformance.	K4

Unit-I (8Hours)

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism- Push rod type, Overhead type (SOHC,DOHC).

Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement,Testing of SI and CI engines.

Unit–II (8Hours)

CombustionandFlamesPropagation:

Chemical composition– Flue gas analysis, Dew point of products, Stoichiometry, Stoichiometry relations, theoreticalairrequiredforcompletecombustion,Enthalpyofformation,Heatingvalueoffuel,Adiabatic flame Temperature, Chemical equilibrium.

Flame stability, Burningvelocity of fuels, Measurement of burning velocity, Factors affecting the burning velocity, Flame Propagation, Flame Temperature– Theoretical, Adiabatic & Actual, Ignition Limits, Limits of Inflammability.

Unit–III (7Hours)

Combustion: StagesofCombustioninSI&CIengine,Factorsaffectingcombustion, Flamespeed,Ignition Delay, Abnormal combustion and its control.

Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Unit-IV **(9Hours)**

Carburetion,Mixturerequirements,Carburetorsandfuelinjection systeminSIEngine,MPFI,Scavenging in 2 Stroke engines.

FuelinjectioninCIengines,Requirements,Typesofinjectionsystems,Fuelpumps,Fuelinjectors, Injection timings.

Turbocharging&itstypes-VariableGeometryTurbocharger,WasteGateTurbocharger,Effectof turbocharging on power & emission.

UNIT-V **(8Hours)**

Engine Emission and Control: Pollutant - Sources and types – Effect on environment and human health - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions - Catalytic converters and Particulate Traps - Selective Catalytic Reduction(SCR) - Diesel Oxidation Catalyst (DOC).

Fuels & Lubricants: Fuels for SI and CI engine, Rating of SI engine and CI engine fuels,Gaseous fuels, LPG, CNG, Biogas, Different cooling systems, Type of lubrication, Lubrication oils, Crankcase ventilation.

TextBooks

3. ACourseinInternationalCombustionEngines,byMathur&Sharma,DhanpatRai&Sons.
4. Fuelsandcombustion,SharmaandChanderMohan,TataMcGrawHill
5. I.CEngine,byGaneshan,TataMcGrawHillPublishers.

Reference Books

7. I.CEngineAnalysis&PracticebyE.FObert.
8. InternalCombustionEngineFundamentals,byJohnB.Heywood,TataMcgrawHillPublishers.
9. EngineEmission,byB.B.Pundir,Narosa Publication.
10. EngineeringFundamentalsofInternalCombustionEnginesbyW.W.Pulkrabek,PearsonEducation.
11. FundamentalsofInternalCombustionEnginebyGill,Smith,Ziurs,Oxford&IBHPublishingCO.
12. FundamentalsofInternalCombustionEnginesbyH.N.Gupta,PrenticeHallofIndia.

Semester–V:DepartmentalElective–II:Specialization–Manufacturingand Automation

SubjectCode:KME 055	Advance welding	L TP:3 0 0	Credits:3

CourseOutcome:Studentwillbeableto		Bloom Taxonomy
CO1	Understandthephysicsofarcweldingprocessandvariousoperating characteristics ofweldingpowersource.	K2
CO2	Analysevariousweldingprocessesandtheirapplications.	K3
CO3	Applytheknowledgeofweldingforrepair&maintenance,alongwiththe weldabilityofdifferent materials.	K3
CO4	Applytheconceptofqualitycontrolandtestingofweldmentsinindustrial environment.	K3
CO5	Evaluateheatflowinweldingandphysicalmetallurgyof weldments.	K4

UNIT-I:

Introduction: Introduction to welding, application, classification and process selection criterion. Health& safety in welding.

Welding Arc: Physics of welding arc, arc initiation, voltage distribution, arc characteristics, arc efficiency, arc temperatures and arc blow.Mechanism and types of metal transfer.

WeldingPowerSources: Typesofweldingpowersources,operationcharacteristicsandspecifications.

UNIT-II:

Welding Processes: Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW) Gas Tungsten Arc Welding (GTAW) Plasma Arc, Submerged Arc Welding, Electro gas and Electroslag, Resistance welding, Friction welding, Brazing, Soldering & Braze welding. Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding.

Advances in Welding Processes: Narrow Gap, Tandem (Twin / Multi Wire) Welding, A-TIG, Hybrid Welding processes**,** Magnetically impelled arc butt (MIAB) welding**,** welding automation and robotic applications.

UNIT-III:

Heat Flow Welding: Weld thermal cycle, Temperature distribution, Peak temperature; Heat Affected Zone (HAZ), heating, cooling and solidification rates.

Welding Metallurgy: Fundamentals of physical metallurgy, Principle of solidification of weld metal, Reactions in weld pool - Gas metal reaction, Slag metal reaction, factors affecting changes in microstructure and mechanical properties of HAZ, Micro and macro structures in weld metal and HAZ

UNIT-IV:

Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding.

Weldability: Effects of alloying elements on weldability, carbon equivalent, welding of plain carbonsteel, Stainless steel, Cast Iron and Aluminium alloys, Welding of Dissimilar Materials

UNIT-V:

Weld Design: Types of welds & joints, Welding Symbols, Weld defects and Remedies, Residual Stresses& Distortion, Inspection and testing of welds: Introduction to Non Destructive Techniques; Destructive Techniques - Bulk and Microhardness test, Wear test and types, corrosion test, tensile test, bend test, SEM, EDS and XRD.

Welding Codes, WPS & PQR: Introduction to welding codes, ISO, ASME and BIS specifications, Welding Procedure Specification (WPS) & Procedure Qualification Record (PQR), Welding of pipe-lines and pressure vessels.

BooksandReferences:

1. WeldingandWeldingTechnology,by-RichardL.Little,McGrawHill Education.
2. WeldingPrincipalsandPractices,by-EdwarsR.Bohnart,McGrawHillEducation.
3. WeldingEngineeringandTechnology,by-R.S.Parmar,KhannaPublishsers.
4. WeldingTechnologyFundamentalsbyWilliam.A. Bowditch.
5. WeldingTechnologybyNK Srinivasan.
6. WeldingEngineeringandTechnology byRSParmar.
7. ModernWeldingTechnology byHowardBCaryandScottHelzer.
8. WeldingHandbooks(Vol.I&II)
9. AdvancedWeldingProcesses,Woodheadpublishing,J. Norrish
10. ASMESec.IX,BoilerandPressureVesselCode

Semester–V:DepartmentalElective–II:Specialization–AutomationandIndustry 4.0

SubjectCode:KME 056	Programming,DataStructuresAndAlgorithms UsingPython	L TP:3 0 0	Credits:3

CourseOutcome:Studentwillbeableto		Bloom Taxonomy
CO1	Understandthenumbers,math'sfunction,strings,list,tuples,anddictionariesin pythons	K2
CO2	Applyconditionalstatementandfunctionsin python	K3
CO3	Applyfilehandlingtechniquesin python	K3
CO4	Analyzethegraphicaldemonstrationinpython	K4
CO5	ApplytechniquesofClassesandObjectConceptinPython	K3

UNIT1:Introduction (8Hours)

Introduction to Python, Python IDE's, Assignment statement, basic types - int, float, complex, bool, Strings, Lists, bytes, byte array, Functions, Loop control statements-break, continue, pass, Anonymous function-filter(),map(),reduce(), more about range().

UNIT2:Data Structure (7Hours)

Arrays vs lists, Tuples and dictionaries, Sets, frozenset, Slicing,binary search, Efficiency, Selection Sort, Insertion Sort, Recursion, Mergesort, Quicksort.

UNIT3:FunctionandFileHandling (8Hours)

Function definitions, Global scope, nested functions, Lambda Function, List Comprehension, Exception Handling, Standard input and output, Handling files, String functions, pass, del() and None

UNIT4:Classes andObject (8Hours)

Generating permutations, Stack, Queue, Circular Queue, Abstract datatypes, classes and objects, Classes and objects in Python, User defined lists, Search trees, Tree, Graph, Hashing

UNIT5:Algorithm (7Hours)

Asymptotic Notation – Big-O, Big Omega, Big Theta Notation, Memorization and dynamic programming, Grid paths, longest common subsequence, Matrix multiplication, Algorithms, and programming: simple gcd, improving naive gcd, Euclid's algorithm for gcd.

Reference Books:

1. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated forPython 3, Shroff/ OReilly Publishers, 2016
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

Semester–V:DepartmentalElective– II:Specialization–Designand Analysis

SubjectCode:KME 057	Mechanical Vibrations	L TP:3 0 0	Credits:3

CourseOutcome:Studentwillbeableto		Bloom Taxonomy
CO1	Understandfundamentalsofmechanicalvibrationsalongwiththeirclassification.	K2
CO2	Differentiateamongsingle,twoandmultipledegreeoffreedom(DOF) systems.	K3
CO3	Analyze,predictandmeasuretheperformanceofsystemsundergoingsingle,two andmultiple DOF.	K4
CO4	Designsystemswithoptimizedvibrationabsorptioncapabilities.	K4
CO5	Applythefundamentalstothereallifeproblemslikewhirlingof shaft	K3
CO6	SolvecomplicatedmathematicalmodelsusingNumericalmethodsandsoftware applications.	K4

UNIT– I (10Hours)

Introduction, Classification of Vibration Systems, Harmonic motion, Vector representation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical method.

Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.

UNIT– II (8Hours)

Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity, and acceleration measuring instruments

UNIT-III (8Hours)

Two Degree Freedom systems Introduction, Principal modes, Double pendulum, Torsional system withdamping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers,Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.

UNIT-IV (10Hours)

Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts.

Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerley's, Holzer's and Stools methods, Rayleigh-Ritz method.

UNIT-V **(8Hours)**

Criticalspeedofshafts,Whirlingofuniformshaft,Shaftwithonediscwithandwithoutdamping, Multi-disc shafts, Secondary critical speed.

Industrialcasestudies(anytwo)involvingmechanicalvibrations,theirimpactandperformanceanalysis. Introduction to the vibration analysis using MATLAB.

BooksandReferences:

1. MechanicalVibrations-V.P.Singh,Dhanpatrai&Co.
2. MechanicalVibrations-G.K.Grover,JainBrothers,Roorkee.
3. MechanicalVibrations-Kelly
4. MechanicalVibrations-Tse,Morse&Hinkle
5. **CasestudyReference#1**:https://www.ijstr.org/final-print/july2018/Vibration-Analysis-Of-Rotating-Machines-With-Case-Studies.pdf
6. **Casestudy Reference#2:** https://www.researchgate.net/publication/254227083_Case_studies_of_vibrations_in_structures
7. **Casestudy Reference#3:** https://pdfs.semanticscholar.org/f2b6/39990c4ba52706f43d02fe1c59b9c3fabf2a.pdf
8. **MOOCreference:**https://www.youtube.com/playlist?list=PLSGws_74K01_pG3R7rgtDtrDZBjcTgPdR

Recommended software packages:

1. MATLAB
2. AnymodellingandFEAtoollikeNX,Solidworksetc.

Semester–V:DepartmentalElective–II:Specialization–ThermalEngineering

SubjectCode:KME 058	FuelsandCombustion	L TP:3 0 0	Credits:3

	Thestudentswillbeableto	Blooms Taxonomy
CO1	Understandthepropertiesofdifferenttypesoffuelwiththeirapplication.	K2
CO2	Classifydifferenttypesoffuels.	K2
CO3	Understandtheconceptofcombustion.	K2
CO4	Understandthefundamentalconceptofairpollutionanditscontrol.	K2
CO5	Calculatevariouspropertiesofthefuels.	K3
CO6	Analyzethefluegases.	K4

Unit-I

ClassificationandPropertiesofFuels:

Fuels-Types and characteristics of fuels-Determination of properties of fuels-Fuel analysis Proximate and ultimate analysis-Calorific value (CV), Gross and net calorific values (GCV,NCV)- Bomb Calorimetry-empirical equations for CV estimation

SolidFuels:

Origin of coal-Ranking of coal-Washing, cleaning,and storageof coal-RenewableSolid Fuels comparative study of Solid, liquid and gaseous fuels-selection of coal for different industrial applications-carbonization of coal

Unit-IILiquid

Fuels:

Origin of crude oil-composition of crude petroleum-classification of crude petroleum-Removal of salt from crude oil-processing of crude petroleum-Fractionation distillation ADU and VDU Cracking-Hydrotreatment and Reforming

Gaseous Fuels:

Rich and lean gas-Wobbe index-Natural gas-Dry and wet natural gas-Foul and sweet NG-LPGLNG-CNG-Methane-Producer Gas-Water gas-Coal Gasification-Gasification Efficiency

Unit-III:CombustionandFlamesPropagation

Chemical composition– Flue gas analysis, Dew point of products, Stoichiometry, Stoichiometry relations, theoreticalairrequiredforcompletecombustion,Enthalpyofformation,Heatingvalueoffuel,Adiabatic flame Temperature, Chemical equilibrium.

Flame stability, Burningvelocity of fuels, Measurement of burning velocity, Factors affecting the burning velocity, Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion, Flame Temperature– Theoretical, Adiabatic & Actual, Ignition Limits, Limits of Inflammability.

Unit-IV:Combustion Equipment

Analysis of flue gases by Orsat apparatus-Combustion of solid fuels-grate firing and pulverized fuel firing system-Fluidized bed combustion-Circulating fluidized bed boiler, Oil Burners, Gas Burners, Factors affectingburnersandcombustion,CombustioninI.C.Engines,Combustioningasturbineandjetengines

Unit-V:AirPollution

Types of pollution, Combustion generated air pollution, Effects of air pollution, Pollution of fossil fuels and its control, Pollution from automobiles and its control,Emission by diesel engines, Emission Standards.

Textbook(s):

1. KennethK.K.,PrinciplesofCombustion,2nded.,WileyPublications,USA,2012
2. SharmaandChanderMohan,Fuelsandcombustion,TataMcGrawHill
3. Phillips H.J., Fuels-solid, liquid, and gases–Their analysis and valuation, 1st ed., Foster Press, USA,2010

Reference Books:

1. SpeightJ.G.,TheChemistryandTechnologyofCoal,3rded.,TaylorandFrancisLtd.,USA,2016
2. SarkarS.,Fuelsandcombustion,3rded.,UniversitiesPress,India,2009

Semester–V:DepartmentalElective–II:Specialization–AutomobileEngineering

SubjectCode:KAU 052	Automotivechassis andsuspension	L TP:3 0 0	Credits:3

CourseOutcomes:Thestudentswillbeableto		Blooms Taxonomy
CO-1	Understanddifferenttypesofautomotivechassisandframesusedin automobiles.	K2
CO-2	Understandtransmissionanddrivelinecomponentsusedinautomobile.	K2
CO-3	Understandtheaxlesandtypesofsteeringsystemin automobile.	K2
CO-4	Understandtheconstructionalfeaturesofbarking,suspensionsystem,wheels and tyres in automobile application.	K2
CO-5	Understandtherecentadvancementsmadeinchassiscomponentsof automobile.	K2
CO-6	Applytheconceptsofbrakingandsteeringsystemtodesignthesamefor automobile application.	K3

UnitI

ChassisLayoutsandFrames

DefinitionofChassis,TypesofChassisLayoutwithreferencetoPowerPlantLocationandDrive

Automotive Frames- Material Selectionand its Constructional Details,Various types, Different Loadsacting on Frame, Testing of Automotive Frames.

UnitII

Transmission: Clutches-Requirementsanditstypes,GearBox:Needandrequirements,Typesofmanual gear boxes, Gear ratio Calculation.

Drive Line: Propeller Shaft - Design Considerations & Constructional Details, Universal Joints, Constant Velocity Joints, Hotchkiss Drive, Torque Tube Drive, Radius Rods and Stabilizers, Final drive - Different types, Multi-axle Vehicles, Differential - Working Principle and Constructional Details, Non–Slip Differential, Differential Locks.

UnitIII

Suspension System: Need; factors influencing ride comfort; types; suspension springs-leaf spring, coil spring & torsion bar; spring materials; independent suspension; rubber suspension; pneumatic suspension; hydraulic suspension, shock absorbers-liquid & gas filled.

Braking Systems: Stopping Distance, Braking Efficiency, Weight Transfer during Braking, Drum Brakes - Constructional Details, Leading and Trailing Shoe, Braking Torque, Disc Brake - Types and Constructional Details, Hydraulic Braking System, Pneumatic Braking System, Power–Assisted Braking System, Factors affecting brake performance, operating temperature, Area of brake lining, clearance.

UnitIV

Axles: Live and Dead Axles, Constructional Details, Different Types of Loads acting on Drive Axles, Rear Axle Shaft Supporting Types: Semi Floating, Full Floating, Three Quarter Floating, Axle Housings and Types

Steering System: Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over Steer and Under Steer, Reversible and Irreversible Steering, Hydraulic Power Assisted Steering, Turning Radius Calculation.

UnitV

Wheels and Tyres: Types of Wheels, Construction, Structure and Function, Forces acting on wheels, Wheel Dimensions, Wheel Balancing, and Wheel Alignment. Structure and Function of Tyres, Static and Dynamic Properties of Pneumatic Tyres, Types of Tyres, Materials, Tyre Section & Designation, Factors affecting Tyre Life, Tyre Rotation.

Bearings:Functions;classificationofbearings;bearingmaterials;automotivebearings.

Recent Trends in Chassis Systems: Special Steering Columns, 4 wheel steering system, Electric Power Steering, Anti–Lock Braking System, Traction Control Systems, Electronic Brake force Distribution Systems, Corner Stability Control, Hill Assist, and Autonomous Braking System.

TextBooks:

1. Automobileengineering",Dr.KripalSingh.
2. Automobileengineering"R.B.Gupta,SatyaPrakashan.

References:

1. HeldtP.M.,"Automotivechassis",ChiltonCo.,NewYork.
2. GilesJ.G.,"Steering,Suspensionandtyres",IliffeBookCo., London.
3. A.K.Babu,AutomotiveMechanics,KhannaPublishingHouse

SubjectCode:KME 601	Refrigeration&AirConditioning	L TP:3 1 0	Credits:4

Thestudentswillbeableto		Blooms Taxonomy
CO1	UnderstandthebasicsconceptsofRefrigeration&Air-Conditioninganditsfuture prospects.	K2
CO2	Explaintheconstructionandworkingofvariouscomponentsin Refrigeration& Air-Conditioningsystems.	K2
CO3	Understandthe differenttypesofRAC systemswiththeirrespectiveapplications.	K2
CO4	Applythebasiclawstothethermodynamicanalysisofdifferentprocesses involvedinRefrigerationandAir-Conditioning.	K3
CO5	ApplythebasicconceptstocalculatetheCOPandotherperformance parameters for different RAC systems	K3
CO6	Analyzetheeffectsofperformanceparametersone COP.	K4

Unit-1 **8Hours**

Refrigeration:

Introduction torefrigeration system,Methods of refrigeration,Unitof refrigeration,Refrigerationeffect, Carnot refrigeration cycle, Refrigerator and Heat Pump, C.O.P.

AirRefrigeration cycle:

Open and closed air refrigeration cycles, Reversed air Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Need of Aircraft refrigeration, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit-2 **8Hours**

VapourCompressionSystem:

Reversed vapour Carnot cycle, limitation of Reversed vapour Carnot cycle, Simple vapour compression cycle, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle,

MultistageSystem:

Multistage vapour compression system requirement, Different configuration of multi pressure system, Removal of flash gas, Intercooling, Multi evaporator system, Cascade system.

Unit-3 **8Hours**

VapourAbsorptionsystem;

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison, Three fluid system.

Refrigerants:
Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants, and Environment friendly refrigerants, Anti-freeze solution, Phase changing materials, Ozone layer depletion and global warming considerations of refrigerants, Selection of refrigerants, Future Refrigerants like Hydrofluoro-Olefines

Unit-4 **8Hours**

AirConditioning:
Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Air Washers, Cooling towers & humidifying efficiency, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).

WindowairConditioner,Simpleairconditioningsystem,Airconditioningsystemwithventilation.

Unit-5 **8Hours**

RefrigerationSystemEquipment:
Compressors, Condensers, Expansion Devices and Evaporators, Elementary knowledge of transmission and distribution of air through ducts and fans,

Application:
Food preservation, Transport refrigeration, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Comfort and Industrial air conditioning Refrigeration.

Othersystems:
Cryogenic liquefaction and refrigeration systems, Brief introduction of Thermo-electric refrigeration system, Steam jet refrigerationsystem, Vortex tube refrigeration system, Magnetic refrigerationsystem.

Reference Books:

1. RefrigerationandAirconditioningbyC.PArora,McGraw-Hill
2. RefrigerationandAirconditioning,byManoharPrasad,NewAgeInternational(P)Ltd. Pub.
3. RefrigerationandAirconditioningbyR.C.Arora,PHI
4. PrinciplesofRefrigerationbyRoyJ.Dossat.Pearson Education
5. RefrigerationandAirconditioningbyStoecker&Jones.McGraw-Hill
6. RefrigerationandAirconditioningbyArora&Domkundwar.DhanpatRai
7. ThermalEnvironmentEngineering.ByKuhen,Ramsey&Thelked

SubjectCode:KME 602	Machine Design	L TP:3 1 0	Credits:4

CourseOutcomes:Thestudentwillbeableto		Blooms Taxonomy
CO1	RecallthebasicconceptsofSolidMechanicstounderstandthe subject.	K2
CO2	Classifyvariousmachineelementsbasedontheirfunctionsand applications.	K2
CO3	Applytheprinciplesofsolidmechanicstomachineelementssubjectedtostatic and fluctuating loads.	K3
CO4	Analyzeforces,bendingmoments,twistingmomentsandfailurecausesinvarious machine elements to be designed.	K4
CO5	Designthemachineelementstomeettherequiredspecification.	K5

UnitI **8Hours**

Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Standards designation of carbon & alloy steels, Selection of preferred sizes, Selection of materials for static and fatigue loads, Design against Static Load

DesignagainstFluctuatingLoads

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Design for finite & infinite life, Soderberg, Goodman, Gerber criteria

UnitII **8Hours**

RivetedJoints

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint

WeldedJoints

Stress relieving of welded joints, Butt Joints, Fillet Joints, Strength of Butt Welds, Strength of parallelfillet welds, Strength of transverse fillet welds

Shafts

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity, Keys, Types of keys, Selection of square and flat keys, Strength of sunk key

UnitIII **8Hours**

SpurGears

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failureof gear tooth, Design of spur gears, AGMA and Indian standards.

HelicalGears

Terminology, Proportions for helical gears, Force components on a tooth of helical gear, Virtual number of teeth, Beam strength and wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

IntroductionClassificationandApplicationsofBevel&WormGears

UnitIV **8Hours**

SlidingContactBearing

Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing.

RollingContactBearing

Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing.

UnitV **8Hours**

ICEngineParts

Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin;

Friction Clutches

Clutches, Difference between coupling and clutch, Single plate friction clutch, Torque transmitting capacity, Multi-Disk Clutches, Friction Material

Note:Designdatabookisallowedinthe examination

TextBooks:

1. DesignofMachineElements-V.B.Bhandari,McGrawHillCo.
2. DesignofMachineElements,SharmaandPurohit,PHI.

Reference Books:

1. MechanicalEngineeringDesign,9e–JosephE.Shigely,McGrawHill Education.
2. MachineDesign-MaleevandHartman,CBS Publishers.
3. DesignofMachineDesign-M.F.Spott,PearsonEducation.
4. ElementsofMachineComponentDesign,Juvinal&Marshek,JohnWiley& Sons.
5. Machinedesign,RobertL.Norton,Pearson Education
6. Theory&ProblemofMachineDesign(Schaum'sOutlineSeries)Hall,Holowenko,Laughlin,Tata McGraw Hill Co.
7. MachineDesign-SharmaandAgrawal,S.K.Kataria&Sons.
8. MachineDesign,UCJindal,Pearson Education.

SubjectCode:KME 603	Theory ofMachines	L TP:3 1 0	Credits:4

CourseOutcomes:Thestudentswillbeableto		Blooms Taxonomy
CO1	Understandtheprinciplesofkinematicsanddynamicsof machines.	K2
CO2	Calculatethevelocityandaccelerationfor4-barandslidercrank mechanism	K3
CO3	Developcamprofileforfollowersexecutingvarioustypesof motions	K3
CO4	Applytheconceptofgear,geartrainandflywheelforpowertransmission	K3
CO5	Applydynamicforceanalysisforslidercrankmechanismandbalancerotating& reciprocating masses in machines.	K3
CO6	Applytheconceptsofgyroscope,governorsinfluctuationofloadandbrake& dynamometerinpowertransmission	K3

UnitI **(09Hours)**

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs andtheir classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

Velocity analysis: Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous center.

Acceleration analysis: Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism,.

UnitII **(10Hours)**

Cams: Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration

Gears and gear trains: Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth ongearandpiniontoavoidinterference, simple,compound,revertedandplanetarygeartrains,sunand planet gear train.

UnitIII **(08Hours)**

Force analysis: Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link inplane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

UnitIV **(09Hours)**

Balancing: Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, balancing of single cylinder engine.

Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor

UnitV **(09Hours)**

Brakes anddynamometers: Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

Gyroscope: Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

Text/Reference Books

1. Kinematicsanddynamicsofmachinery:WilsonandSadler,Thirdedition, Pearson.
2. TheoryofMechanismsandMachines:AmitabhGhoshandAshokKumarMallik,ThirdEdition Affiliated East-West Press.
3. TheoryofMachinesandMechanisms:JosephEdwardShigleyandJohnJosephUicker,Jr.Oxford University Press
4. Kinematicsanddynamicsofmachinery: RLNorton,McGrawHill
5. TheoryofMachines:S.S.Rattan,McGrawHill
6. TheoryofMachines:ThomasBevan,CBS Publishers.

Suggested Software

MechAnalyzer

SubjectCode:KME 651	Refrigeration&AirConditioningLab	L TP:0 0 2	Credits:1

Thestudentswillbeableto:		Blooms Taxonomy
CO1	Determinetheperformanceofdifferentrefrigerationandair-conditioningsystems.	K3
CO2	Applytheconceptofpsychrometry ondifferentaircoolingsystems.	K3
CO3	Interprettheuseofdifferentcomponents,controlsystemsandtoolsusedinRAC systems	K3
CO4	DemonstratetheworkingofpracticalapplicationsofRACsystems.	K2

Minimumeightexperimentsoutofthefollowing:

1. Experimentonrefrigerationtestrigandcalculationofvariousperformanceparameters.
2. Experimentonair-conditioningtest rig&calculationofvariousperformance parameters.
3. StudyofPsychrometeranddeterminationofhumidityofairusingSlingPsychrometer.
4. Tostudyandperformexperimentonvapourabsorption apparatus.
5. Tostudythe airwasherandperformdifferentpsychometricprocessesonairwasher.
6. Studyofdesertcoolersanddeterminethechangeintemperatureandhumidityofambientair.
7. Handling,useandfamiliarizationwithrefrigerationtoolsandaccessoriessuchas:Tubecutter; Tube bender [spring type]; Flaring tool; Swaging tool; Pinch off etc.
8. Studyofwindowair conditioner.
9. StudyofHermeticallysealed compressor.
10. Tostudybasiccomponentsandcontroldevicesofrefrigerationandair-conditioningsystem.
11. ExperimentonIce-plantandcalculationofvariousperformanceparameters.
12. Visitofacentralairconditioningplantanditsdetailed study.
13. Visitofcold-storageanditsdetailed study.

SubjectCode:KME 652	Machine DesignLab	L TP:0 0 2	Credits:1

CourseOutcomes:Thestudentwillbeableto		Blooms Taxonomy
CO-1	Applytheprinciplesofsolidmechanicstodesignvariousmachine Elements subjected to static and fluctuating loads.	K3
CO-2	Writecomputerprogramsandvalidateitforthedesignofdifferentmachine elements	K4
CO-3	Evaluatedesignedmachineelementstocheck theirsafety.	K5

A DesignofMachine Elements

1. Designaknucklejointsubjectedtogiventensile load.
2. Designarivetedjointsubjectedtogiveneccentricload.
3. Designofshaftsubjectedtocombinedconstanttwistingandbending loads
4. Designatransversefilletweldedjointsubjectedtogiventensileload.
5. Design&selectsuitableRollingContactBearingforashaftwithgivenspecifications
6. DesignacylinderheadofanICEnginewithprescribedparameters.
7. DesignofPiston&itspartsofanICEngine

B.ComputerProgramsforconventionaldesign

Computer and Language

StudentsarerequiredtolearnthebasicsofcomputerlanguagesuchasC/C++/MATLABsothatthey should be able to write the computer program.

1. DesignapairofSpurGearwithgivenspecificationstodetermineitsvariousdimensionsusing Computer Program in C/C++.
2. DesignapairofHelicalGearwithgivenspecificationstodetermineitsvariousdimensionsusing Computer Program in C/C++.
3. DesignofSlidingContactBearingwithgivenspecifications&determineitsvariousparametersusing Computer Program in C/C++.

SubjectCode:KME 653	TheoryofMachinesLab	L TP:0 0 2	Credits:1

Thestudentswillbeableto:		Blooms Taxonomy
CO1	Demonstratevariousmechanisms,theirinversionsandbrakeandclutchesin automobiles	K2
CO2	Applycam-followermechanismtogetdesiredmotionof follower.	K3
CO3	Applytheconceptsofgearsandgeartraintogetdesiredvelocityratioforpower transmission.	K3
CO4	Applytheconceptofgovernorstocontrolthefuelsupplyin engine.	K3
CO5	Determinethebalancingloadinstaticanddynamicbalancingproblem	K3

ListofExperiments

(Minimumeightexperimentsoutofthefollowing)

NOTE: Student has to write computer program in C / C++ / Python and to run to compute the outputvalues for at least ONE experiments.

1. Tostudyvarioustypesofkinematicslinks,pairs,chains& Mechanisms
2. TostudyWhitworthQuickReturnMotionMechanisms,ReciprocatingEngineMechanism,and Oscillating Engine Mechanism
3. Tostudyofinversionsoffourbar linkage
4. Tostudyofinversionsofsingle/doubleslidercrankmechanisms
5. Tostudyvarioustypesofgear(Helical,crosshelical,worm,bevelgear)andgearprofile(involute and cycloidal) and condition for interference Helical, cross helical, worm, bevel gear
6. Tocomputetheoutputvelocityinvariousgeartrains
7. Tostudygyroscopiceffectsthrough models
8. Todeterminegyroscopiccoupleon MotorizedGyroscope
9. Toperformexperimentondeadweighttypegovernortoprepareperformancecharacteristic Curves, and to find stability & sensitivity
10. Toperformexperimentonspringcontrolledgovernortoprepareperformancecharacteristic Curves, and to find stability & sensitivity
11. Todetermine whirlingspeedofshafttheoreticallyandexperimentally
12. Toperformtheexperimentforstatic/dynamicbalancing
13. Toperform experimentonbrake
14. Toperform experimentonclutch
15. Toperformtheexperimentforstatic/dynamicbalancing.
16. Toperformexperimentonlongitudinalvibration
17. Toperformexperimentontransverse vibration

Semester–VI:DepartmentalElective–III:Specialization–Manufacturingand Automation

SubjectCode:KME 061	NondestructiveTesting	L TP:3 0 0	Credits:3

CourseOutcome:Studentwillbeableto		Bloom Taxonomy
CO1	UnderstandtheconceptofdestructiveandNon-destructivetestingmethods.	K2
CO2	Explaintheworkingprincipleandapplicationofdiepenetranttestandmagnetic particleinspection.	K2
CO3	Understandtheworkingprinciple ofeddycurrentinspection.	K2
CO4	Applyradiographictechniquesfortesting.	K3
CO5	Apply theprincipleofUltrasonic testingandapplicationsinmedical andengineering areas.	K3

Unit-I:

Introduction to NDT, DT, advantages & limitations of NDT, classification of NDT methods, ComparisonwithDT,Terminology, Flaws and Defects. Scope of NDT.Codes, Standards and Certifications in NDT.

Visual Inspection– Equipment used for visual inspection, Borescopes, Application of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection, Visual Inspection in Welding.

Unit-II:

Liquid Penetrant Testing – Principle, Scope, Testing equipment, Advantages, Limitations, types of penetrants and developers, standard testing procedure, Zyglo test, Illustrative examples and interpretation of defects.

MagneticParticleInspection–Principle,Scope,Testingequipment,Advantages,Limitations,Application of MPI & standard testing procedure, DC & AC magnetization, Skin Effect, different methods to generate magnetic fields, Illustrative examples and interpretation of defects.

Unit-III:

Radiographic Testing – Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photoelectric effect, coherent scattering and Incoherent scattering, Beam geometry.

X-ray Radiography – Principle, equipment & methodology, applications, source, types of radiations and limitations; γ-ray Radiography – Principle, equipment, γ-ray source & technique; Radiography Image Quality Indicators, Film Processing, advantages of γ-ray radiography over X-ray radiography. Precautions against radiation hazards.

Unit-IV:

Ultrasonic Testing – Introduction, Principle, Piezoelectricity and Piezoelectric Transducers, Wave propagation, Ultrasonic probes, selection of angle probes, Acoustic Impedance, Reflection and transmission coefficient, Snell's law, standard testing procedure & calibration, advantages & limitations. Data representation - A-scan, B-scan, C-scan. Applications in inspection of welded joints, castings, forgings and dimensional measurements. Introduction to TOFD & Phased Array Ultrasonic Testing.

Unit-V:

SpecialNDT Techniques:

EddyCurrentInspection–Introduction,Principle,Methods,scope,Equipment,typesofprobes, Sensitivity, standard testing procedure, advanced ECT methods, advantages and limitations.

AcousticEmissionTechnique–Introduction,TypesofAEsignal,Principle,Advantages&Limitations, Interpretation of Results, Applications.

Holography,Thermography–Introduction,Principle,advantages,limitationsandapplications.

BooksandReferences:

1. Non-DestructiveTestingandEvaluationofMaterials,by-Prasad,McGrawHillEducation.
2. PracticalNon-destructiveTesting,by-BaldevRaj,T.Jayakumar,M.Thavasimuthu,Woodhead Publishing.
3. Non-DestructiveTestingTechniques,by-RaviPrakash,NewAgeInternational.
4. NondestructiveTestingHandbook,byRobertC.McMaster,AmericanSocietyfor Nondestructive.
5. IntroductiontoNondestructiveTesting:ATrainingGuide,by-PaulE.Mix,wiley.
6. ElectricalandMagneticMethodsofNon-destructiveTesting,by-J.Blitz,springer.
7. PracticalnondestructivetestingbyRaj,Baldev.
8. BasicsofNon-DestructiveTesting,byLari&Kumar,KATSON Books.
9. ASMESec.V,boiler andpressurevesselcode

Semester–VI:DepartmentalElective–III:Specialization–AutomationandIndustry 4.0

SubjectCode:KME 062	ArtificialIntelligence	L TP:3 0 0	Credits:3

CourseOutcomes:Studentsareableto		Bloom's Taxonomy
CO1	UnderstandconceptsofArtificialIntelligence	**K2**
CO2	SolveproblembySearch-I&Search-II	**K3**
CO3	UnderstandKnowledgerepresentation	**K2**
CO4	ApplyconceptsofLearningmethods	**K3**
CO5	AnalyseDecisionNetworks	**K4**
CO6	Buildplanninggraphs	**K5**

Unit1: **(9Hours)**

Introduction of Artificial Intelligence, Intelligent Agents, and Behaviors of Artificial Agents, Structure of Intelligent Agents. Problem solving and state space search, Uninformed Search, Heuristic search, Best-First Search, Heuristic Functions, Constraints satisfaction problem, Iterative Improvement Algorithms.

(Recommended lab practice sessions: Games as Search Problems, Alpha-Beta Pruning, State-of-the-Art Game Programs.)

Unit2: **(8Hours)**

Introduction to Knowledge Representation, Propositional Logic, 1st order logic-I, 1st order logic-II, Inference in First-Order Logic, Using First-Order Logic, Building a Knowledge Base, Logical Reasoning Systems; Indexing, Retrieval, and Unification, Inference in FOL-II, Answer Extraction.

Unit3: **(9Hours)**

Procedural control of reasoning, reasoning under uncertainty, Bayesian Networks, Decision Networks, Uncertain knowledge and reasoning, The Axioms of Probability, Bayes' Rule and Its Use, Probabilistic Reasoning Systems, Making Simple Decisions, Making Complex Decisions, Introduction to Planning, Practical Planning and Acting, Inductive Learning, Learning from Observations.

Unit4: **(7Hours)**

Neural Networks: Learning in Neural Networks, How the Brain Works, Perceptron, Multilayer Feed-Forward Networks, Applications of Neural Networks, Introduction to Learning, Kinds of Learning, Supervised and Unsupervised Learning, Clustering, Reinforcement Learning.

Learning a Function, Aspects of Function Learning, and Types of function learning aspects: Memory, Averaging and Generalization, Example problems based on Function Learning.Learning methods,Nearest Neighbor, Decision Trees, and Neural Networks.

Unit5: **(7Hours)**

Intelligent Agents, Types of Communicating Agents, A Communicating Agent, Practical Natural Language Processing: Practical Applications, Efficient Parsing, Scaling Perception: Image-Processing Operations for EarlyVision,UsingVisionforManipulationandNavigation,SpeechRecognition.Robotics:Tasks:What

AreRobotsGoodFor?Parts:WhatAreRobotsMadeOf?Architectures,ConfigurationSpaces:A Framework for Analysis, Navigation and Motion Planning

TextBook:

1. StuartRussell,PeterNorvig,“ArtificialIntelligence–AModernApproach”,PearsonEducation

Reference Books:

2. ElaineRichandKevinKnight,“ArtificialIntelligence”,McGraw-Hill
3. ECharniakandDMcDermott,“IntroductiontoArtificialIntelligence”,PearsonEducation
4. DanW.Patterson,“ArtificialIntelligenceandExpertSystems”,PrenticeHallof India,

Semester–VI:DepartmentalElective–III:Specialization–DesignandAnalysis

SubjectCode:KME 063	Tribology	L TP:3 0 0	Credits:3

CourseOutcome:Studentwillbeableto		Bloom Taxonomy
CO1	Identifyandexplainvariousfrictionandwear mechanisms.	K2
CO2	Selectproperlubricantsfordifferentapplications.	K3
CO3	Selectsuitablelubricationmethodsindifferent bearings.	K3
CO4	Studythesurfacescoatingtechniquesforreductionof wear.	K3
CO5	Analyzetheimpactoffrictioninvariouskinematic pairs.	K4

UNIT–I LubricationandLubricants

Introduction to tribology, tribology in industry, basics modes of lubrication, oil viscosity, temperature and pressure dependence of viscosity, Viscosity index, viscosity measurement, properties of lubricants, temperature characteristics of lubricants, lubricant impurities and contaminants, mineral oils based lubricants, synthetic oils based lubricants, emulsions and aqueous lubricants, greases, and lubricant additives.

UNIT–II Frictionand Wear

Friction-causes of friction, theories of dry friction; adhesion theory, abrasive theory, junction growth theory, laws of rolling friction, friction measurement, friction instabilities.

Wear- classification; abrasive wear, erosive wear, cavitation wear, adhesive wear, corrosive wear, oxidative wear, fatigue wear, factors affecting wear, measurement of wear, theories of wear,approaches to friction control and wear prevention.

UNIT–III LubricationofBearings

Theoryofhydrodynamic lubrication,mechanismofpressuredevelopmentinoilfilm,jetlubrication,mist lubrication, lubrication utilizing under race passage, concept of journal bearing, minimum oil film thickness, porous bearings, flat plate thrust bearing, tilting pad bearings, hydrostatic lubrication,squeeze film lubrication, elasto-hydrodynamic lubrication, rolling element bearings, gas lubricated bearings, and hybrid bearings.

UNIT–IVSolidLubricationandSurfaceTreatment

Lubrication by solids, friction and wear characteristics of lamellar solids, reduction of friction by soft metallic films, deposition methods of solid lubricants, techniques for producing wear resistant coatings, characteristics of wear resistant coatings.

UNIT–V Friction,LubricationandWearin Kinematicpairs

The concept of friction angle, friction stability, friction in slideways, friction in screws with square threads,frictioninscrewswithtriangularthreads,mechanismandoperationofplateclutch,coneclutch, rim clutch, centrifugal clutch, and belt drives, tribo design aspects of labyrinth seals, analysis of line contact lubrication, analysis of point contact lubrication, cam follower system, traction in the contact zone, and hysteresis losses.

BooksandReferences:

1. FundamentalsofEngineeringTribologywithApplicationsbyHarishHirani,CambridgeEnglish (2017)

2. AppliedTribology(BearingDesignandLubrication),byMichaelMKhonsari,JohnWiley&Sons (2001).
3. PrinciplesofTribology,byJHalling,TheMacmillanPressLtd,London, (1975).
4. Friction,Wear,Lubrication:AtextbookinTribology,byLudemaKC,CRCPress,(2010).
5. Fundamentals of Machine Elements, B.J. Hamrock, B.O. Jacobson & S.R. Schmid, McGraw-Hill Inc., (1998).
6. Fundamentals of Mechanical Component Design, by K.S. Edwards & R.B. McKee, McGraw-Hill Inc., (1991).
7. MechanicalEngineeringDesignbyJ.E.ShigleyandCRMischke,TataMcGraw-HillPublishingCompany Limited, (2003).
8. Tribophysics,byN.P.SuhPrentice-Hall,(1986).
9. Friction, Wear, Lubrication: A Textbook in Tribology, by Kenneth C Ludema, LayoAjayi, CRC Press(2019).

Semester–VI:DepartmentalElective–III:Specialization–Thermal Engineering

SubjectCode:KME 064	GasDynamics andJetPropulsion	L TP:3 0 0	Credits:3

CourseOutcomes:Thestudentswillbeableto		Blooms Taxonomy
CO1	Understandtheconceptofcompressiblefluidflowandflowthroughvariable areaducts.	K2
CO2	Understandthebasicprinciple andtypesofjetandrocketpropulsion.	K2
CO3	Applythebasiclawsfortheinvestigationofflowthroughducts.	K3
CO4	Applythebasiclawsforthethermodynamicsanalysisofjetandrocket propulsion.	K3
CO5	Analyzethecompressibleflowthroughvariableareaducts.	K4

UNIT-I:
Compressibleflow,definition,MachwavesandMachcone,stagnationstates,Mass,momentumand energy equations of one-dimensional flow.

UNIT-II:
Isentropic flow through variable area ducts, nozzles and diffusers, subsonic and supersonic flow variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

UNIT-III:
Non-isentropicflowinconstantareaducts,RayleighandFanoflows,Normalshockrelations,oblique shock relations, isentropic and shock tables.

UNIT-IV:
Theoryofjetpropulsion,thrustequation,thrustpowerandpropulsiveefficiency,Operatingprinciple and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT-V:
Typesofrocketengines,propellants&feedingsystems,ignitionandcombustion,theoryofrocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.

BooksandReferences:
1. AhmedF.El-Sayed,AircraftPrpoulsionandGasTurbineEngines,CRCPress,2008.
2. H.S.Mukunda,"UnderstandingAerospaceChemicalPropulsion",InterlinePublishing,2004.
3. HillP.andPetersonC.,Mechanics&ThermodynamicsofPropulsion,Addison Wesley,1992.
4. ZucrowN.J.,AircraftandMissilePropulsion,Vol.I&II,JohnWiley, 1975.
5. SuttonG.P.,RocketPropulsionElements,JohnWiley,NewYork,1986.

Semester–VI:DepartmentalElective–III:Specialization–Automobile Engineering

SubjectCode:KAU 061	AutomotiveElectricalandElectronics	L TP:3 0 0	Credits:3

Thestudentswillbeableto		Blooms Taxonomy
CO-1	Understandthebasicconceptsofelectricalsystemsusedin automobile.	K2
CO-2	Understand the constructional features of charge storage devices and methods to test these devices for their healthy operation.	K2
CO-3	Understand the principles and characteristics of charging and starting system of automobile and study the various faults occurring in system.	K2
CO-4	Understand theignitionandauxiliarysystem- types&constructionalfeatures used in automobile.	K2
CO-5	Describe the principles and architecture of electronics systems and its componentspresentinanautomobilerelatedtodatatransfer,instrumentation, control, and security systems.	K2
CO-6	Understandlatesttrendsdevelopedinelectricalandelectronicsystemsofautomobile and their advantages over conventional technologies.	K2

Unit1 **[L8Hours]**

Introduction to electrical fundamentals – Ohm's Law, Kirchhoff's Law, Capacitance and Inductance, Simple Electric Circuits, Automotive Wiring Harnesses, Insulated and Earth Return System, Positive and Negative Earth Systems, Connectors and its types

Charge storing devices- Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal, Hybrid Battery, Sodium Sulphur Battery and Aluminum Air Battery-Choice of Batteries for automotive applications,CharacteristicsofBattery,BatteryRating,Capacity andEfficiency,VariousTests on Battery, Battery– Charging Techniques. Maintenance of batteries.

Unit2 **[L8Hours]**

Starter Systems- Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids.
Chargingsystemcomponents,GeneratorsandAlternators,types,constructionand Characteristics,

ChargingSystem-VoltageandCurrentRegulation,Cut–outrelaysandregulators,Chargingcircuitsfor D.C.Generator,A.C.SinglePhaseandThree–PhaseAlternator

Unit3 **[L8Hours]**

Automotive Ignition Systems: Spark Plugs, Constructional details and Types, Battery Coil and Magneto– Ignition System Circuit details and Components, Centrifugal and Vacuum Advance Mechanisms, Non–Contact–typeIgnitionTriggeringdevices,CapacitiveDischargeIgnition,Distributor–lessIgnitionSystems

Auxiliary Systems: Head Lamp and Indicator Lamp construction and working details, Focusing of head lamps, Anti– Dazzling and Dipper Details, Automotive Wiring Circuits. Indicators and meters, speedometers, electric horn, windshield wiper, electric horn and relay devices.

Unit4 **[L8Hours]**

Automotive Electronics: Automotive networking, Bus system, Advantages of bus systems, requirements ofbuses,Busesinmotor vehicle:CAN,FlexRay,LIN,Ethernet,IP,PSI5,MOSTbusandopticalfibers/wave guides, Architectures of electronic system.

Control Units: ECM, ABS control unit, Steering Control Unit, SRS control unit, Automatic Air Conditioning Control Unit.

Unit5 **[L8Hours]**

Automotive Sensors and Actuators: Basic principle, Main requirements, Micromechanics, Position sensors,SpeedandRPMsensors,Accelerationandvibrationsensors, Pressuresensors,Flowmeters,Gas sensors, concentration sensors, temperature sensors, Force sensors, Optoelectronics sensors, Sensors for driver assistance systems: Ultrasonic technology, Radar technology, LIDAR sensors Purge Control, Idling Setting Control, Immobilizer System, Stepper motors.

Books:

1. AutomotiveElectricalsbyPLKohli,McGrawHillPublications.
2. RobertBosch“AutomotiveHandBook”,SAE(8thEdition),2011.

References:

1. TomDenton,“AutomobileElectricalandElectronicSystems”4thedition-Routledge- 2012.
2. BarryHollembeak,“AutomotiveElectricityandElectronics”,DelmarCengageLearning;5thedition, 2011

SubjectCode:KNC501/KNC601	ConstitutionofIndia,Lawand Engineering	L TP:2 0 0	Credits:0

Module1--IntroductionandBasicInformationaboutIndianConstitution:

Meaning of the constitution law and constitutionalism, Historical Background of the ConstituentAssembly, Government of India Act of 1935 and Indian Independence Act of 1947,EnforcementoftheConstitution,IndianConstitutionanditsSalientFeatures,ThePreambleofth eConstitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy,Parliamentary System, Federal System, Centre-State Relations, Amendment of the ConstitutionalPowers and Procedure, The historical perspectives of the constitutional amendments in India,Emergency Provisions: National Emergency, President Rule, Financial Emergency, and LocalSelfGovernment–ConstitutionalSchemeinIndia.

Module2-UnionExecutiveandStateExecutive:

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers andFunctions of the President, Comparison of powers of Indian President with the United States,Powers and Functions of the Prime Minister, Judiciary – The Independence of the SupremeCourt, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism,LokPal, LokAyukta, The Lokpal and Lokayuktas Act 2013, State Executives – Powers andFunctions of the Governor, Powers and Functions of the Chief Minister, Functions of StateCabinet,FunctionsofState Legislature,FunctionsofHighCourtandSubordinate Courts.

Module3- IntroductionandBasicInformationaboutLegalSystem:

TheLegalSystem: SourcesofLawandtheCourtStructure:Enactedlaw-ActsofParliamentare of primary legislation, Common Law or Case law, Principles taken from decisions of judgesconstitute binding legal rules. The Court System in India and Foreign Courtiers (District Court,DistrictConsumerForum,Tribunals,HighCourts,SupremeCourt).Arbitration:Asanalternative to resolving disputes in the normal courts, parties who are in dispute can agree thatthiswill instead bereferred toarbitration.Contract law,Tort,Lawatworkplace.

Module4-IntellectualPropertyLawsandRegulationtoInformation:

IntellectualPropertyLaws:Introduction,LegalAspectsofPatents,FilingofPatentApplications,Rights fromPatents,InfringementofPatents,CopyrightanditsOwnership,InfringementofCopyright,CivilRe mediesforInfringement,RegulationtoInformation-Introduction, Right to Information Act, 2005, Information Technology Act, 2000, ElectronicGovernance,SecureElectronicRecordsandDigitalSignatures,DigitalSignatureCertificates ,CyberRegulationsAppellateTribunal,Offences,Limitationsof theInformationTechnologyAct.

Module5-BusinessOrganizationsandE-Governance:

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of aCompany,MemorandumofAssociation,ArticlesofAssociation,Prospectus,Shares,

Directors,GeneralMeetingsandProceedings,Auditor,Windingup.

E-Governance and role of engineers in E-Governance, Need for reformed engineering serving atthe Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation andSecessionisminfew statescreatinghurdlesinIndustrialdevelopment.

CourseObjective:

- Toacquaintthestudentswithlegaciesofconstitutionaldevelopmentin India and helpthosetounderstand themostdiversifiedlegaldocument ofIndiaand philosophy behindit.
- Tomakestudentsawareofthetheoreticalandfunctionalaspectsofthe Indian Parliamentary System.
- Tochannelizestudents'thinkingtowardsbasicunderstandingofthelegalconceptsanditsimplications forengineers.
- Toacquaintstudentswithlatestintellectualpropertyrightsandinnovationenvironmentwithrelated regulatoryframework.
- Tomakestudentslearnaboutroleofengineeringinbusinessorganizationsande-governance.

CourseOutcome: Attheend ofthecourse,learnersshouldbeableto**-**

1. Identifyandexplorethebasicfeaturesandmodalitiesabout Indianconstitution.
2. Differentiateand relatethefunctioningofIndianparliamentarysystematthecenterandstate level.
3. DifferentiatedifferentaspectsofIndianLegalSystemanditsrelatedbodies.
4. Discoverandapplydifferentlawsandregulationsrelatedtoengineeringpractices.
5. Correlateroleofengineerswithdifferentorganizationsandgovernancemodels

Pedagogy: Lecture,Problembasedlearning,Groupdiscussions,Visualmedia,Films,Documentaries, Debateforums.

SuggestedReadings:

- BrijKishoreSharma:*IntroductiontotheIndianConstitution*,8th Edition,PHILearningPvt.Ltd.
- GranvilleAustin:*TheIndianConstitution:CornerstoneofaNation(ClassicReissue)*,OxfordUniversityPress.
- SubhashC.Kashyap:*OurConstitution:AnIntroductiontoIndia'sConstitutionandconstitutionalLaw*,NBT,2018.
- MadhavKhosla:*TheIndianConstitution*, OxfordUniversityPress.
- PMBakshi:*TheConstitutionofIndia*,LatestEdition, UniversalLawPublishing.
- V.K.Ahuja: *LawRelating to IntellectualPropertyRights*(2007)
- SureshT.Viswanathan:*TheIndianCyberLaws,BharatLawHouse*,NewDelhi-88
- P.Narayan:IntellectualPropertyLaw,EasternLawHouse,NewDelhi
- PrabudhGanguli:*GearingupforPatents:TheIndianScenario*,OrientLongman.
- BLWadehra:Patents,Trademarks,*DesignsandGeologicalIndicationsUniversalLaw* Publishing-LexisNexis.

- IntellectualPropertyRights:LawandPractice,ModuleIIIbyICSI(onlyrelevantsections)
- Executive programme study material Company Law, Module II, by ICSI (The Institute ofCompaniesSecretariesofIndia)(Onlyrelevantsectionsi.e.,Study1,4and36).https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
- Handbook on e-Governance Project Lifecycle, Department of Electronics & InformationTechnology,GovernmentofIndia,https://www.meity.gov.in/writereaddata/files/e-Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf

- Companies Act, 2013 Key highlights and analysis by PWC.https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlights-and-analysis.pdf

ReferredCaseStudies:

- KeshavanandBharatiV.StateofKerala,AIR1973SC1461.
- ManekaGandhiV.UnionofIndiaAIR,1978 SC597.
- S.R.BammaiV.UnionofIndia,AIR1994 SC1918.
- KuldipNayyar V. UnionofIndia,AIR2006SC312.
- A.D.M.JabalpurV.ShivkantShakla,AIR1976SC1207.
- Remshwar PrasadV. UnionofIndia,AIR2006SC980.
- KeshavSingh inre,AIR1965 SC745.
- UnionofIndiaV.Talsiram,AIR1985SC1416.
- AtiabariTea EstateCo.V.StateofAssam,AIR1961SC232.
- SBP&Co.Vs.PatelEngg.Ltd.2005(8)SCC618.
- KrishnaBhagyaJalaNigamLtd.Vs.G.ArischandraReddy(2007)2SCC720.
- Oil&NaturalGasCorporationVs.SawPipesLtd.2003 (4)SCALE92 – 185.

**** (Other relevant case studies can be consulted by the teacher as per the topic).PrescribedLegislations:**

1. InformationTechnologyAct, 2000withlatestamendments.
2. RTIAct 2005withlatestamendments.
3. InformationTechnologyRules, 2000
4. Cyber RegulationAppellateTribunalRules,2000

SuggestedaidforStudentsandPedagogicpurpose

- RSTVdebatesoncorporatelaw,IPRand patentissues
- NPTELlecturesonIPRand patentrights

Episodes of 10 -part mini TV series "Samvidhan: The Making of Constitution of India" byRSTV.

SubjectCode:KNC502/KNC602	IndianTraditions,CulturalandSociety	L TP:2 0 0	Credits:0

Module1-Society StateandPolityinIndia

State in Ancient India: Evolutionary Theory, Force Theory, Mystical Theory Contract Theory,Stages of State Formation in Ancient India, Kingship , Council of Ministers AdministrationPolitical Ideals in Ancient India Conditions' of the Welfare of Societies, The Seven Limbs of theState, Society in Ancient India, Purusārtha, Varnāshrama System, Āshrama or the Stages of Life,Marriage, Understanding Gender as a social category, The representation of Women in Historicaltraditions,Challengesfacedby Women.Four-classClassification,Slavery.

Module2-IndianLiterature,Culture,Tradition,andPractices

Evolution of script and languages in India: Harappan Script and Brahmi Script. The Vedas, theUpanishads,the Ramayana and the Mahabharata, Puranas, BuddhistAndJain Literature inPali,Prakrit And Sanskrit, Kautilya'sArthashastra, Famous Sanskrit Authors, Telugu Literature,Kannada Literature,Malayalam Literature ,Sangama Literature Northern Indian Languages &Literature,PersianAndUrdu,HindiLiterature

Module3-IndianReligion,Philosophy,andPractices

Pre-VedicandVedicReligion,Buddhism,Jainism,SixSystemIndianPhilosophy,Shankaracharya, Various Philosophical Doctrines , Other Heterodox Sects, Bhakti Movement,Sufimovement, Socioreligiousreformmovementof19thcentury,Modernreligiouspractices.

Module4-Science,ManagementandIndianKnowledgeSystem

Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture inIndia, Medicine in India ,Metallurgy in India, Geography, Biology, Harappan Technologies,WaterManagementinIndia,TextileTechnologyinIndia,WritingTechnologyinIndia PyrotechnicsinIndiaTradein AncientIndia/,India'sDominanceupto Pre-colonialTimes

Module5- CulturalHeritageandPerformingArts

IndianArchitect,EngineeringandArchitectureinAncientIndia,Sculptures,Seals,coins,Pottery, Puppetry, Dance, Music, Theatre, drama, Painting, Martial Arts Traditions, Fairs andFestivals,Currentdevelopmentsin Arts andCultural,Indian's Cultural Contribution totheWorld.IndianCinema

COURSEOBJECTIVES:

- The course aims at imparting basic principles of thought process, reasoning and inferenceto identify the roots and details of some of the contemporary issues faced by our nationand tryto locate possiblesolutionsto these challengesbydiggingdeepinto ourpast.
- To enable the students to understand the importance of our surroundings and encouragethe studentstocontributetowards sustainable development.

- Tosensitizestudentstowardsissuesrelatedto‘Indian’culture,traditionanditscomposite character.
- To make students aware of holistic life styles of Yogic-science and wisdom capsules inSanskritliteraturethatareimportantinmodernsocietywithrapidtechnologicaladvancementsandsocietaldisruptions.
- Toacquaintstudentswith IndianKnowledgeSystem,Indian perspectiveof modernscientificworld-viewand basicprinciplesofYogaandholistichealthcaresystem.

CourseOutcomes
:Abilitytounderstand,connectupandexplainbasicsofIndianTraditionalknowledgemodernscientificperspective.

SuggestedPedagogyforTeachers

- Projectbasedlearning
- Casestudies
- Groupdiscussion
- Presentations

SuggestedText &ReferenceBooks

1. V.Sivaramakrishna(Ed.),*CulturalHeritageofIndia-CourseMaterial*,BharatiyaVidyaBhavan,Mumbai,5thEdition,2014
2. S.Baliyan, *IndianArtandCulture*, OxfordUniversityPress, India
3. SwamiJitatmanand,*ModernPhysicsandVedant*,BharatiyaVidyaBhavan
4. RomilaThapar,*ReadingsInEarlyIndianHistory*Oxford UniversityPress,India
5. FritzofCapra,Tao ofPhysics
6. FritzofCapra,Thewave ofLife
7. VNJha(EnglishTranslation),*TarkasangrahaofAnnamBhatta,*InernationalChinmayFoundation,Velliarnad,Amaku,am
8. YogaSutraofPatanjali,RamakrishnaMission,Kolkatta
9. GNJha(Eng.Trans.)Ed.RNJha,*Yoga-darshanamwithVyasaBhashya*,VidyanidhiPrakasham,Delhi,2016
10. RNJha,ScienceofConsciousnessPsychotherapyandYogaPractices,VidyanidhiPrakasham,Delhi,2016
11. PRSharma(Englishtranslation), ShodashangHridayam
12. Basham,A.L., *TheWonderthatwasIndia*(34thimpression), NewDelhi, Rupa&co
13. Sharma,R.S.,*AspectsofPoliticalIdeasandInstitutionsinAncientIndia*(fourthedition),Delhi,MotilalBanarsidass,

SubjectCode:KOE065	Computer Based Numerical Techniques	L TP:3 0 0	Credits:3

Open Elective I

CourseObjectives:

- Toapplytheknowledgeoferrors,rootsandapplicationinthefieldofengineering.
- Todealdealswithfinitedifferencesandinterpolationtosolveengineeringproblemsinvolvingcomplicatedreallifesituationsetc.
- To deal with numerical integration and differentiation that is required in different branches ofEngineering to graduate engineers for applying more difficult problems in case of complexstructures.
- To deals with numerical solution of differential Equations for engineering problems involvingreallifesituationsetc.
- Todealwithboundaryvalueproblemsofreallifesystemsand Engineers.

Unit 1[L8Hours]

Error and roots of Algrabraic and Transcendental Equations: Introduction ofNumbers and their accuracy, Computer Arithmetic, Mathematical preliminaries,ErrorsandtheirComputation,Generalerrorformula,Errorinaseriesapproximation. SolutionofAlgebraicandTranscendentalEquation**:**BisectionMethod,Iterationmethod,Methodoffalseposition,Newton-Raphsonmethod,Methodsoffinding real and complexroots, Muller's method, Rateof convergenceof Iterativemethods,PolynomialEquations.

Unit 2[L8Hours]

Interpolation: IntroductionFiniteDifferences,DifferencetablesPolynomialInterpolation:Newton'sforwardandbackwardformulaCentralDifferenceFormulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett'sformula.Interpolationwithunequalintervals:Lagrange'sInterpolation,Newton Divideddifferenceformula,Hermite'sInterpolation.

Unit 3[L8Hours]

NumericalIntegrationandDifferentiation:Introduction:Numericaldifferentiation of Newton's forward and backward formula, Stirling's, Bessel's,Everett'sformula,Lagrange'sInterpolationandNewtonDivideddifferenceformula.

Numerical Integration: Newton cotes formula, Trapezoidal rule, Simpson's 1/3 and3/8rules,Boole'srule,Waddle'srule.

Unit 4[L8Hours]

SolutionofdifferentialEquations: Introduction,Picard'sMethod,Euler'sMethod,Taylor'sMethod,Runge-KuttaMethods,PredictorCorrectorMethods,AutomaticErrorMonitoringandStabilityofsolution.

Unit 5[L8Hours]

Boundary Value problems: Introduction, Finite difference method, solving Eigenvalue problems, polynomial method and power methods. Numerical solution ofPartialDifferentialequations.Elliptic,ParabolicandhyperbolicPDEs.DistillationinaPlateColumn,Unsteady-stateOperation,StartingaStirred-tankReactor,RateatwhichaPlateAbsorberApproachesSteadyState.

Note:PS:Practicesession:StudentsshouldpracticetheFlowChartsandalgorithmofsomeimportantprograms

TextBooks:

1. Jain,IyengarandJain,"NumericalMethodsforScientificandEngineeringComputations", NewAgeInternational.
2. GrewalBS,"NumericalmethodsinEngineeringandScience",KhannaPublishers,Delhi**.**

ReferenceBooks

1. RajaramanV,ComputerOrientedNumericalMethods,PearsonEducation
2. TVeerarajan,TRamachandran,"TheoryandProblemsinNumericalMethods,McGrawHill
3. PradipNiyogi,NumericalAnalysisandAlgorithms,McGrawHill.
4. FrancisScheld,NumericalAnalysis,McGrawHill.
5. SastryS.S,IntroductoryMethodsofNumericalAnalysis,PearsonEducation.
6. Kiusalaas,J.:NumericalmethodsinengineeringwithMATLAB,CambridgeUniversityPress
7. Woodford,C andPhillips,C:Numericalmethodswithworkedexamples:MATLABEdition,Springer

COURSEOUTCOMES: Attheendofthiscourse,thestudentswillbeableto:

	CourseOutcome(CO)	**Bloom's KnowledgeLevel(KL)**
CO1	Understandtheconceptoferrorstoevaluateapproximaterootsofseveraltypesofequations	K_2&K_5
CO2	Analyzetheproblemandevaluatedatabydifferentinterpolationmethodsandcreatinginterpolatinggraphs	K_4,K_5&K_6
CO3	Understandtheconceptofinterpolationtoanalyzeandevaluatethenumericaldifferentiationandintegration	K_2&K_5
CO4	Remember the concept of formula based the solution of ordinarydifferentialequationstoevaluatedifferentialequationswithyinitialconditions	K_1&K_5
CO5	Applytheconceptofpartialdifferentialequationtoevaluatethepartialdifferentialequations	K_3&K_5

K_1–Remember,K_2–Understand,K_3–Apply,K_4–Analyze,K_5–Evaluate,K_6–Create