EvaluationScheme&Syllabusfor
B. Tech.

(MechanicalEngineering)

ASPER

AICTEMODELCURRICULUM

UNDER

Facultyof Technology
w.e.f.Session2021-22

B.Tech. Mechanical Engineering is a 4 year undergraduate engineering degree course. This coursepreparesthestudentstobecomeMechanicalEngineers.Theobjectiveofthiscourseis to prepare students to apply the principles of mechanical engineering for designing, manufacturing, and maintenance of mechanical systems.

PROGRAMOUTCOMES(POs)

Program Outcomes (POs)	Description
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineeringfundamentals,andanengineeringspecializationtothesolutionof complex engineering problems.
PO2	Problemanalysis:Identify,formulate,reviewresearchliterature,andanalyze complexengineeringproblemsreachingsubstantiatedconclusionsusingfirst principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/developmentofsolutions:Designsolutionsforcomplexengineering problemsanddesignsystemcomponentsorprocessesthatmeetthespecified needswithappropriateconsiderationforthepublichealthandsafety,andthe cultural, societal, and environmental considerations
PO4	Conductinvestigationsofcomplexproblems:Useresearch-basedknowledgeand research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO5	Moderntoolusage:Create,select,andapplyappropriatetechniques,resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. -long learninginthebroadestcontextoftechnologicalchange.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledgetoassesssocietal,health,safety,legalandculturalissuesandthe consequentresponsibilitiesrelevanttotheprofessionalengineeringpractice.
PO7	Environment and sustainability: Understand the impact of the professional engineeringsolutionsinsocietalandenvironmentalcontexts,anddemonstratethe knowledge of, and need for sustainable development.
PO8	Ethics:Applyethicalprinciplesandcommittoprofessionalethicsand responsibilities and norms of the engineering practice.
PO9	Individualandteamwork:Functioneffectivelyasanindividual,andasa member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehendandwriteeffectivereportsanddesigndocumentation,makeeffective presentations, and give and receive clear instructions.
PO11	Projectmanagementandfinance:Demonstrateknowledgeandunderstandingof theengineering andmanagement principles andapply these toone'sownwork, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-longlearning:Recognizetheneedfor,andhavethepreparationandability to engage in independent and life

KALINGAUNIVERSITYNAYARAIPUR
BachelorofTechnology(MechanicalEngineering)
w.e.fAcademicSession2021-22

B-Tech(ME)1st Semester							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME101	**ProgrammingforProblem Solving**	3	0	3	70	30	100
BTME102	**EmergingDomaininElectronics Engineering**	3	0	3	70	30	100

BTME103	**EngineeringChemistry**	3	1	4	70	30	100
BTME104	**EngineeringMathematics-I**	3	1	4	70	30	100
BTME105	**English**	2	0	2	70	30	100
BTME106-P	**EngineeringChemistry-Lab**	0	2	1	30	20	50
BTME107-P	**EmergingDomaininElectronics Engineering-Lab**	0	2	1	30	20	50
BTME108-P	**ProgrammingforProblem Solving-Lab**	0	2	1	30	20	50
BTME109-P	**MechanicalWorkshop-Lab**	0	2	1	30	20	50
Total		**14**	**10**	**20**	**470**	**230**	**700**

B-Tech(ME)2nd Semester							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME201	**FundamentalsofMechanical Engineering & Mechatronics**	3	0	3	70	30	100
BTME202	**BasicElectricalEngineering**	3	0	3	70	30	100
BTME203	**EngineeringPhysics**	3	1	4	70	30	100
BTME204	**EngineeringMathematics-II**	3	1	4	70	30	100
BTME205	**ArtificialIntelligencefor Engineers**	2	0	2	70	30	100
BTME206P	**EngineeringPhysics-Lab**	0	2	1	30	20	50
BTME207P	**BasicElectricalEngineering-Lab**	0	2	1	30	20	50
BTME208P	**EnglishLanguage-Lab**	0	2	1	30	20	50
BTME209P	**EngineeringGraphics&Design- Lab**	0	2	1	30	20	50
Total		**14**	**10**	**20**	**470**	**230**	**700**
*TheMiniProjectorinternship(3-4weeks)conductedduringsummerbreakafterIIsemesterandwillbe							

assessedduringIIIsemester.

B.Tech(ME)-ThirdSemester							
Subject Code	**Subject**	**Lecture**	**Tutorial/ Practical**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME301	**Mathematics-III**	3	1	4	70	30	100
BTME302	**Technical Communication**	3	0	3	70	30	100
BTME303	**Thermodynamics**	3	1	4	70	30	100
BTME304	**EngineeringMechanics**	3	1	4	70	30	100
BTME305	**MaterialsEngineering**	3	1	4	70	30	100
BTME306P	**EngineeringMechanics-Lab**	0	2	1	30	20	50
BTME307P	**MaterialTesting-Lab**	0	2	1	30	20	50
BTME308P	**Computer Aided MachineDrawing-I**	0	2	1	30	20	50
BTME309P	**Mini Project or InternshipAssessment***	0	2	2	30	20	50
Total		**15**	**12**	**24**	**470**	**230**	**700**

B.Tech(ME)-FourthSemester							
Subject Code	**Subject**	**Lecture**	**Tutorial/ Practical**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME401	**Measurement&** Metrology	3	0	3	70	30	100
BTME402	**UniversalHuman Values**	3	0	3	70	30	100
BTME403	**Applied Thermodynamics**	3	0	3	70	30	100

BTME404	**FluidMechanics& Fluid Machines**	3	1	4	70	30	100
BTME405	**Manufacturing Process**	3	1	4	70	30	100
BTME406P	**Applied Thermodynamics-Lab**	0	2	1	30	20	50
BTME407P	**Manufacturing Process-Lab**	0	2	1	30	20	50
BTME408P	**FluidMachines-Lab**	0	2	1	30	20	50
BTME409P	Measurement& Metrology -Lab	0	2	1	30	20	50
Total		**15**	**10**	**21**	**470**	**230**	**700**
*****Theinternship(6weeks)conducteddduringsummerbreakafterIVsemesterandwill be assessed during V semester.							

B.Tech(ME)-FifthSemester							
Subject Code	**Subject**	**Lecture**	**Tutorial/ Practical**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME501	HeatandMass Transfer	3	1	4	70	30	100
BTME502	StrengthofMaterial	3	1	4	70	30	100
BTME503	IndustrialEngineering	3	1	4	70	30	100
-	**Departmental Elective-I**	3	0	3	70	30	100
BTME504A	ComputerIntegrated						

	Manufacturing						
BTME504B	MechatronicsSystems						
BTME504C	FiniteElement Methods						
BTME504D	ICEngineFueland Lubrication						
BTME504E	AutomobileEngines& Combustion						
-	**Departmental Elective-II**	3	0	3	70	30	100
BTME505A	AdvanceWelding						
BTME505B	Programming,Data Structures And Algorithms Using Python						
BTME505C	MechanicalVibrations						
BTME505D	FuelsandCombustion						
BTME505E	AutomotiveChassis and Suspension						
BTME506P	**HeatandMass Transfer Lab**	0	2	1	30	20	50
BTME507P	**ComputerAided MachineDrawing-II-Lab**	0	2	1	30	20	50
BTME508P	Automobile Engineering-Lab	0	2	1	30	20	50
BTME509P	MiniProjector InternshipAssessment*	0	2	2	30	20	50
Total		**15**	11	**23**	**470**	**230**	**700**

B.Tech(ME)-SixthSemester							
Subject Code	**Subject**	**Lecture**	**Tutorial/ Practical**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME601	RefrigerationandAir Conditioning	3	1	4	70	30	100
BTME602	MachineDesign	3	1	4	70	30	100
BTME603	Theoryof Machine	3	1	4	70	30	100
BTME604	**DepartmentalElective-III**	3	0	3	70	30	100
BTME604A	NondestructiveTesting						
BTME604B	ArtificialIntelligence						

BTME604C	Tribology						
BTME604D	GasDynamicsandJet Propulsion						
BTME604E	AutomotiveElectrical and Electronics						
-	**OpenElective-I**	3	0	3	70	30	100
BTMEOE605A	RealTime Systems						
BTMEOE605B	EmbeddedSystem						
BTMEOE605C	IntroductionToMems						
BTMEOE605D	ObjectOriented Programming						
BTMEOE605E	NumericalTechniques						
BTMEOE605F	GIS&RemoteSensing						
BTMEOE605G	UnderstandingThe Human Being Comprehensively-HumanAspirations AndIts Fulfillment						
BTME606P	RefrigerationandAir Conditioning Lab	0	2	1	30	20	50
BTME607P	MachineDesign Lab	0	2	1	30	20	50
BTME608P	TheoryofMachineLab	0	2	1	30	20	50
Total		**15**	**9**	**21**	**440**	**210**	**650**

***Theinternship(6weeks)conductedduringsummerbreakafterVIsemesterandwill be assessed during VII semester.

B-Tech(ME)7th Semester							
SubjectCode	**Subject**	**L**	**T/P**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total**
BTME701	CAD/CAM	3	1	4	70	30	100
	DepartmentalElective-IV	3	0	3	70	30	100
BTME702A	PowerPlantEngineering						
BTME702B	AdditiveManufacturing						

BTME702C	VehicleBodyEngineeringand Safety						
	DepartmentalElective-V	3	0	3	70	30	100
BTME703A	Automation&Robotics						
BTME703B	Modelling& Simulation						
BTME703C	ComputationalFluidDynamics						
BTME703D	AutomotiveTransmission						
BTME703E	LeanManufacturing						
	OpenElective-II	3	0	3	70	30	100
BTMEOE704A	Digital&SocialMedia Marketing						
BTMEOE704B	IdeatoBusinessModel						
BTMEOE704C	MachineLearning						
BTMEOE704D	RenewableEnergyResources						
BTMEOE704E	OperationResearch						
BTMEOE704F	Value Relationship & Ethical HumanConduct–ForAHappy & Harmonious Society						
BTME705P	CAD/CAM-Lab	0	2	1	30	20	50
BTME706P	MinorProject	0	6	3	100	50	150
BTME707P	InternshipAssessment	0	2	2	30	20	50
Total		**12**	**11**	**19**	**440**	**210**	**650**

B-Tech(ME)8thSemester							
SubjectCode	**Subject**	**L**	**T/P**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total**
BTME801	ProjectManagement&Entrepreneurship	3		3	70	30	100
	DepartmentalElective-VI	3		3	70	30	100
BTME802A	FlexibleManufacturingSystem						
BTME802B	AdvanceManufacturingScience						

BTME802C	HybridVehiclePropulsion						
	OpenElective-III	3		3	70	30	100
BTMEOE803A	FilterDesign						
BTMEOE803B	Bioeconomics						
BTMEOE803C	DesignThinking						
BTMEOE803D	IntroductiontoWomen's& Gender Studies						
BTMEOE803E	QualityManagement						
BTMEOE803F	ModelingofFieldEffectsNano Devices						
BTMEOE803G	ComputerizedProcessControl						
BTME804P	Project	0	18	9	200	100	300
Total		**9**	**18**	**18**	**410**	**190**	**600**

SEMESTERI

ProgrammingforProblemSolvingB

TME101

SubjectCode: BTME101	Programmingforproblemsolving	LTP:300	Credits:3

Courseobjectives

Toapplylogicalandcreativeapproachestosolvingproblemsandmakingdecisions. Use

traditional and creative tools for identifying causes and generating solutions.

Employcreativityandlateralthinkingasbusinesstools.Analyzeandsolveactualproblems facing them at work

Module – 1 : **(Introduction to Programming)** **[08]**

Introductiontocomponentsofacomputersystem: Memory,processor,I/ODevices,storage, operating system, Concept of assembler, compiler, interpreter, loader and linker.

IdeaofAlgorithm: RepresentationofAlgorithm,Flowchart,Pseudocodewithexamples,From algorithms to programs, source code.

Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C, Fundamental data types, Variables and memory locations, Storage classes.

Module – 2 : **(Arithmetic expressions & Conditional Branching)** **[08]**

Arithmeticexpressionsandprecedence: Operatorsandexpressionusingnumericandrelational operators,mixedoperands,typeconversion,logicaloperators,bitoperations,assignmentoperator, operator precedence and associativity.

Conditional Branching: Applying if and switch statements, nesting if and else, use of break and default with switch.

Module– 3:**(Loops & Functions)**

Iterationandloops:useofwhile,dowhileandforloops,multipleloopvariables,useofbreakand continue statements.

Functions: Introduction,typesoffunctions,functionswitharray,passingparameterstofunctions, callby value, call by reference, recursive functions.

Module– 4:**(Arrays& BasicAlgorithms)** **[08]**

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, Passing arrays to functions.

Basic Algorithms: Searching &Basic Sorting Algorithms (Bubble, Insertion and Selection), Findingroots of equations, Notion of order of complexity.

Module–5:**(Pointer&FileHandling)** **[08]**

Pointers: Introduction, declaration, applications, Introduction to dynamic memory allocation(malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (noimplementation)
File handling: File I/O functions, Standard C preprocessors, defining and calling macros, command-line arguments.

CourseOutcomes

1. Todevelopsimplealgorithmsforarithmeticandlogicalproblems.
2. Totranslatethealgorithmstoprograms&execution(inC language).
3. Toimplementconditionalbranching,iterationandrecursion.
4. Todecomposeaproblemintofunctionsandsynthesizeacompleteprogramusingdivideand conquer approach.
5. Tousearrays,pointersandstructurestodevelopalgorithmsand programs.

Text books:

1. Schum‟sOutlineofProgrammingwithCbyByronGottfried,McGraw-Hill.
2. TheCprogrammingbyKernighanBrainW.andRitchieDennisM.,PearsonEducation.
3. ComputerBasicsandCProgrammingbyV.Rajaraman,PHILearningPvt.Limited,2015
4. ComputerConceptsandProgramminginC,R.S.Salaria,KhannaPublishingHouse
5. ComputerConceptsandProgramminginC,EBalaguruswami,McGrawHill
6. ComputerScience-AStructuredProgrammingApproachUsingC,byBehrouz
7. A.Forouzan,RichardF.Gilberg,Thomson,ThirdEdition,CengageLearning– 2007.
8. LetUs CByYashwantP. Kanetkar.
9. ProblemSolvingandProgramDesigninC,byJeriR.Hanly,ElliotB.Koffman,Pearson.
10. ProgramminginCbyKochanStephenG.PearsonEducation–2015.
11. ComputerConceptsandProgramminginCbyD.S.YadavandRajeevKhanna,New AgeInternational Publication.
12. ProblemSolvingandProgramminginC,R.S.Salaria,KhannaPublishingHouse

ProgrammingforProblemSolvingLabBTME10

8P

SubjectCode: BTME108P	ProgrammingforproblemsolvingLab	LTP:002	Credits:1

Courseobjectives

1ToDesignsolutionstosimpleengineeringproblembyapplyingthebasicprogrammingprinciplesofC language and basic mathematical knowledge.

2.ChooseasuitableC-constructtodevelopCcodeforagivenproblem.

OtherReference:-UseCOpenSourceSoftwarereferringSpokenTutorialMOOC

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by thestudent.
2. WAPthatcalculatestheSimpleInterestandCompoundInterest.ThePrincipal,Amount,Rateof Interest and Time are entered through the keyboard.
3. WAPtocalculatetheareaandcircumferenceofa circle.
4. WAPthatacceptsthetemperatureinCentigradeandconvertsintoFahrenheitusingtheformula C/5=(F-32)/9.
5. WAPthatswapsvaluesoftwovariablesusingathird variable.
6. WAPthatcheckswhetherthetwonumbersenteredbytheuserareequalornot.
7. WAPtofindthegreatest ofthreenumbers.
8. WAPthatfindswhetheragivennumberisevenorodd.
9. WAPthattellswhetheragivenyearisaleapyearornot.
10. WAPthatacceptsmarksoffivesubjectsandfindspercentageandprintsgradesaccordingtothe following criteria:
    Between90-100%----------Print,,A‟‟
    Between80-90%---------- Print,,B‟‟
    Between60-80% ---------- Print,,C‟‟
    BetweenBelow60%----------Print,,D‟‟
11. WAPthattakestwooperandsandoneoperatorfromtheuserandperformtheoperationandprintsthe result by using Switch statement.
12. WAPtoprintthesumofallnumbersuptoagivennumber.
13. WAPtofindthefactorialofagivennumber.
14. WAPtoprint sum ofevenandoddnumbersfrom 1toN numbers.
15. WAPtoprinttheFibonacciseries.
16. WAPtocheckwhethertheenterednumberisprimeornot.
17. WAPtofindthesumofdigitsoftheenterednumber.
18. WAPtofindthereverseofa number.
19. WAPtoprint Armstrongnumbersfrom 1to100.
20. WAPtoconvertbinarynumberintodecimalnumberandvice versa.
21. WAPthatsimplytakeselementsofthearrayfromtheuserandfindsthesumoftheseelements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
23. WAPtofindtheminimumandmaximumelementofthearray.

24. WAPtosearchanelement inaarrayusingLinear Search.
25. WAPtosorttheelementsofthearrayinascendingorderusingBubbleSort technique.
26. WAPtoaddandmultiplytwomatricesoforder nxn.
27. WAPthatfindsthesumofdiagonalelementsofamxn matrix.
28. WAPtoimplementstrlen(),strcat(),strcpy()usingtheconceptofFunctions.
29. Define a structure data type TRAIN_INFO. The type contain Train No.: integer type Train name: string Departure Time: aggregate type TIME Arrival Time: aggregate type TIME Start station: string Endstation:stringThestructuretypeTimecontainstwointegermembers:hourandminute.Maintain a train timetable and implement the following operations:
    (i) Listallthetrains(sortedaccordingtotrainnumber)thatdepartfromaparticularsection.
    (ii) Listallthetrainsthatdepartfromaparticularstationataparticulartime.
    (iii) List all he trains that depart from a particular station within the next one hour of a given time.
    (iv) Listallthetrainsbetweenapairofstartstationandendstation.
30. WAPtoswaptwoelementsusingtheconceptof pointers.
31. WAPtocomparethecontentsoftwofilesanddeterminewhethertheyaresameornot.
32. WAPto check whethera given wordexists in afileornot.Ifyes then find the numberoftimesit occurs.

CourseOutcomes

1. Towriteprogramsforarithmeticandlogicalproblems.
2. Totranslatethealgorithmstoprograms&execution(inC language).
3. Towriteprogramsforconditionalbranching,iterationandrecursion.
4. To write programs using functions and synthesize a complete program using divide andconquer approach.
5. writeprogramsusingarrays,pointersandstructures.

EMERGINGDOMAININELECTRONICSENGINEERING

(BTME102)

SubjectCode: BTME102	EMERGING DOMAIN IN ELECTRONICSENGINEERING	LTP:300	Credits:3

Courseobjective:Thiscourseprovidesthestudentwiththefundamentalskillstounderstand the basic of semiconductor and components like diode, transistor, FET, MOSFET and operational amplifier It will build mathematical and numerical background for design of electronics circuit & component value.

Unit	Topics	Lectures
I	**SemiconductorDiode**:Depletionlayer,V-Icharacteristics,idealandpractical Diodes, DiodeEquivalentCircuits,ZenerDiodesbreakdownmechanism(Zenerand avalanche)	**3**
	DiodeApplication: DiodeConfiguration,HalfandFullWaverectification,Clippers, Clampers,Zenerdiodeasshuntregulator,Voltage-MultiplierCircuits	**3**
	SpecialPurposetwoterminalDevices: Light-EmittingDiodes,PhotoDiodes, Varactor Diodes, Tunnel Diodes, Liquid-Crystal Displays.	**2**
II	**BipolarJunctionTransistor:**TransistorConstruction,Operation,Amplification action.CommonBase,CommonEmitter,CommonCollectorConfiguration	**4**
	FieldEffectTransistor: ConstructionandCharacteristicofJFETs.TransferCharacteristic. MOSFET (MOS) (Depletion and Enhancement) Type, Transfer	**4**
III	**OperationalAmplifiers:**Introduction,Op-AmpBasic,PracticalOp-AmpCircuits (InvertingAmplifier,Non-invertingAmplifier,UnitFollower,SummingAmplifier, Integrator, Differentiator).Differential and Common-Mode Operation, Comparators.	**4**
	Introduction of IoT System, Components of IoT system: Microprocessor and Microcontroller, Bluetooth Technology, Wi-Fi Technology, Concept of Networking, Sensor Nodes, concept of cloud.	**4**
IV	**DigitalElectronics:**Numbersystem&representation.IntroductionofBasicand UniversalGates,usingBooleanalgebrasimplificationofBooleanfunction.KMap Minimization upto 6 Variable.	**6**
	IntroductionToICTechnology:SSI,MSI,LSI,VLSIIntegratedCircuits.	

	FundamentalsofCommunicationEngineering: Basicsofsignalrepresentationand analysis, Electromagnetic spectrum Elements of a Communication System, Need of modulation and typical applications, Fundamentals of amplitude modulation and demodulation techniques.	**4**
V	**IntroductiontoDataCommunications:** GoalsandapplicationsofNetworks.	
	GeneralModelofWirelessCommunication:Evolutionofmobileradio communicationfundamentals,GPRS,GSM,CDMA.ElementsofSatellite&Radar Communication,	**4**

CourseOutcomes:Attheendofthiscoursestudentswilldemonstratetheabilityto:

1. UnderstandtheconceptofPNJunctionanddevices.
2. UnderstandtheconceptofBJT,FETandMOFET.
3. UnderstandtheconceptofOperationalamplifier
4. Understandtheconceptofmeasurement instrument.
5. Understandtheworkingprincipleofdifferenttypeofsensorandtheiruses.
6. UnderstandtheconceptofIoTsystem&UnderstandthecomponentofIoT system

Text Books:

1. RobertL.Boylestand/LouisNashelsky"ElectronicDevicesandCircuitTheory",Pearson Education.
2. HSKalsi,"ElectronicInstrumentation",McGrawPublication
3. GeorgeKennedy,"ElectronicCommunicationSystems",McGrawPublication
4. DavidA.Bell,"ElectronicDevicesandCircuits",OxfordUniversityPress.
5. JacobMillman,C.C.Halkias,StayabrataJit,"ElectronicDevicesandCircuits",McGraw Hill
6. DavidA.Bell,ElectronicInstrumentationandMeasurements,LatestEdition,Oxford University Press India

EMERGINGDOMAININELECTRONICSENGINEERING-Lab (BTME107P)

SubjectCode: BTME108P	**EMERGING DOMAIN IN ELECTRONICSENGINEERING-Lab**	**LTP:002**	**Credits:1**

CourseObjectives

TodesignandanalyzevariousElectroniccircuitssuchasmultivibrators,applicationsof operational amplifiers, RC coupled amplifiers, oscillators, digital circuits etc.

SuggestiveListof Experiments:

PartA

1. StudyofvarioustypesofActive&PassiveComponentsbasedontheirratings.
2. IdentificationofvarioustypesofPrintedCircuitBoards(PCB)andsolderingTechniques.
3. PCBLab:a.Artwork&printingofasimplePCB.b.Etching&drillingofPCB
4. Windingshop:Stepdowntransformerwindingoflessthan 5VA.
5. Soldering shop: Soldering and disordering of Resistor in PCB. Soldering and disordering ofIC in PCB. Soldering and disordering of Capacitor in PCB

PartB

1. StudyofLabEquipmentsandComponents:CRO,Multimeter,andFunctionGenerator, Power supply- Active, Passive Components and Bread Board.
2. P-NJunctiondiode:CharacteristicsofPNJunctiondiode-Staticanddynamicresistance measurement from graph.
3. ApplicationsofPNJunctiondiode:Half&Fullwaverectifier-MeasurementofVrms, Vdc, and ripple factor.
4. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
5. CharacteristicofBJT:BJTinCE configuration.
6. TostudyOperationalAmplifierasAdderandSubtractor
7. VerificationofTruthTableofVariousLogicGate.
8. ImplementationofthegivenBooleanfunctionusinglogicgatesinbothSOPandPOS forms.

CO1:AbilitytoanalyzePNjunctionsinsemiconductordevicesundervariousconditions.

CO2:Abilitytodesignandanalyzesimplerectifiersandvoltageregulatorsusingdiodes. CO 3: Ability to describe the behavior of special purpose diodes.

CO4:Abilitytodesignand analyzesimpleBJTandMOSFETcircuits.

ENGINEERINGCHEMISTRY

BTME103

SubjectCode: BTME103	ENGINEERINGCHEMISTRY	LTP:300	Credits:3

Courseobjectives

The objective of the Engineering Chemistry is to acquaint the students with the basic phenomenon/conceptsofchemistry,thestudentfaceduringcourseoftheirstudyintheindustryand Engineering field

Module-1 **[08]**

AtomicandMolecularStructure:

Molecular orbital's of diatomic molecules. Band theory of solids. Liquid crystal and its applications.Point defects in solids. Structure and applications of Graphite and Fullerenes. Concepts of Nanomaterials and its application.

Module-2 **[08]**

SpectroscopictechniquesandApplications:

ElementaryideaandsimpleapplicationsofRotational,Vibrational,Ultraviolet&VisibleandRaman spectroscopy.

Module-3 **[08]**

Electrochemistry

Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system.

Module-4 **[08]**

Water Analysis; Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchangeresin and Reverse osmosis method).

Fuels:classificationof fuels,Analysisofcoal,Determinationof calorific value(Bomb calorimeterand Dulong'smethos).

Module-5 **[08]**

Polymer; Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparationandapplicationof some industriallyimportant polymers (Buna-S,Buna-N, Neoprene,Nylon- 6, nylon-6,6 and Terylene) . General methods of synthesis of organometallic compounds (Grignard reagent) and their applications.

CourseOutcomes:

1. Useofdifferentanalyticalinstruments.
2. Measuremolecular/systempropertiessuchassurfacetension,viscosity,conductanceofsolution, chloride and iron content in water.
3. Measurehardnessofwater.
4. Estimatetherateconstantof reaction.

ReferenceBooks:

1. UniversityChemistryByB.H.Mahan
2. UniversityChemistryByC.N.R.Rao
3. OrganicChemistryByI.L.Finar
4. PhysicalChemistryByS.Glasstone
5. EngineeringChemistryByS.S.Dara
6. PolymerChemistryByFreW.,Billmeyer
7. EngineeringChemistryBySatyaPrakash

ENGINEERINGCHEMISTRY- PRACTICAL

BTME106P

SubjectCode: BTME106P	**ENGINEERINGCHEMISTRY-PRACTICAL**	**LTP:002**	**Credits:1**

Courseobjectives

ToProvidethestudentswithasolidfoundationinChemistrylaboratoryrequiredtosolveengineering problems.

- Practicalimplementationoffundamentalconcepts.

ListOfExperiments

1. Determinationofalkalinityinthegivenwater sample.
2. DeterminationoftemporaryandpermanenthardnessinwatersampleusingEDTA.
3. DeterminationofironcontentinthegivensolutionbyMohr'smethod.
4. Determinationofviscosityofgivenliquid.
5. Determinationofsurfacetensionofgiven liquid.
6. Determinationofchloridecontentinwatersample.
7. Determinationofavailablechlorineinbleachingpowder.
8. DeterminationofpHbypH-metrictitration.
9. PreparationofPhenol-formaldehydeandUrea-formaldehyderesin.
10. DeterminationofCellconstantandconductanceofasolution.
11. Determinationofrateconstantofhydrolysisof esters.
12. VerificationofBeer'slaw.

CourseOutcomes:

1. Useofdifferentanalyticalinstruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measurehardnessofwater.
4. Estimatetherateconstantof reaction.

NOTE:Choiceofany8experimentsfromthe above.

ENGINEERINGMATHEMATICS-I

BTME104

SubjectCode: BTME104	**ENGINEERINGMATHEMATICS-I**	**LTP:300**	**Credits:3**

Courseobjectives

Be able to apply problem-solving and logical skills. Have a deeper understanding of mathematical theory. Haveasolidknowledgeofelementarystatistics.Beabletocommunicatemathematical/logicalideasinwriting

Module1: Matrices **[08]**

Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix using elementary transformations, Rank-Nullity theorem; System of linear equations, Characteristic equation, Cayley-Hamilton Theorem and its application, Eigen values and eigenvectors; Diagonalisation of a Matrix.

Module2:DifferentialCalculus-I **[08]**

Introduction to limits, continuity and differentiability, Rolle's Theorem, Lagrange's Mean value theorem and Cauchy mean value theorem, Successive Differentiation (n^{th} order derivatives), Leibnitz theorem and its application, Envelope, Involutes and Evolutes, Curve tracing: Cartesian and Polar co-ordinates.

Module3:DifferentialCalculus-II **[08]**

Partial derivatives, Total derivative, Euler's Theorem for homogeneous functions, Taylor and Maclaurin's theorems for a function of one and two variables, Maxima and Minima of functions of several variables, Lagrange Method of Multipliers, Jacobians, Approximation of errors.

Module4:MultivariableCalculus-I **[08]**

Multipleintegration: Doubleintegral,Tripleintegral,Changeoforderofintegration, Change of variables, **Application:** Areas andvolumes, Center of mass and center of gravity (Constant and variable densities).

Module5:Vector Calculus **[08]**

Vectordifferentiation:Gradient,CurlandDivergenceandtheirPhysicalinterpretation,Directional derivatives, Tangent and Normal planes.

VectorIntegration:Lineintegral,Surfaceintegral,Volumeintegral,Gauss'sDivergencetheorem,Green's theorem, Stoke's theorem (without proof) and their applications.

CourseOutcomes

1. Remembertheconceptofmatricesandapplyforsolvinglinearsimultaneousequations.
2. Understandtheconceptoflimit,continuityanddifferentiabilityandapplyinthestudyofRolle,s, Lagrange,s and Cauchy mean value theorem and Leibnitz theorems .
3. Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.

4. Illustrate the working methods of multiple integral and apply for finding area, volume, centre of mass and centre of gravity.
5. Remembertheconceptofvectorandapplyfordirectionalderivatives,tangentandnormalplanes. Also evaluate line, surface and volume integrals.

Text Books:-

1. B.V.Ramana,HigherEngineeringMathematics,TataMcGraw-HillPublishingCompanyLtd.,2008.
2. B.S.Grewal,HigherEngineeringMathematics,KhannaPublisher,2005.
3. RK.Jain&SRK.Iyenger,AdvanceEngineeringMathematics,NarosaPublishingHouse 2002.

ReferenceBooks-

1. E.Kreyszig,AdvanceEngineeringMathematics,JohnWiley&Sons, 2005.
2. PeterV.O'Neil,AdvanceEngineeringMathematics,Thomson(Cengage)Learning,2007.
3. MauriceD.Weir,JoelHass,FrankR.Giordano,Thomas,Calculus,EleventhEdition,Pearson.
4. D.Poole,LinearAlgebra:AModernIntroduction,2ndEdition,Brooks/Cole, 2005.
5. VeerarajanT.,EngineeringMathematicsforfirstyear,TataMcGraw-Hill,NewDelhi, 2008.
6. RayWylieCandLouisCBarret,AdvancedEngineeringMathematics,TataMc-Graw-Hill;Sixth Edition.
7. P.SivaramakrishnaDasandC.Vijayakumari,EngineeringMathematics,1stEdition,PearsonIndia Education Services Pvt. Ltd
8. AdvancedEngineeringMathematics.ChandrikaPrasad,ReenaGarg,2018.
9. EngineeringMathemathics–I.ReenaGarg,2018.

ENGLISH

BTME105

SubjectCode: BTME105	ENGLISH	LTP:300	Credits:3

Courseobjectives

TheobjectivesofEnglishlanguagelearningare

I) Toenablethestudentscomprehendthespokenform
II) II)TodevelopstudentsabilitytouseEnglishinday-to-daylifeandreallife situation
III) III)Tounderstandthewrittentextandabletouseskimming,scanningskills
IV) IV)TowritesimpleEnglishtoexpress

Module1-BasicsofTechnicalEnglish [08]

TechnicalEnglish:Definition;Extent&Coverage;Dimensions;Reading;Skimming:Scanning Churning & Assimilation; Writing: Methods: Inductive; Deductive; Exposition; Linear; Interrupted; Spatial & Chronologicaletc;TechnicalCommunication;Approaches:Brevity;Objectivity;Simplicity;Utility&Clarity.
Listening: Active; Passive; Thinking strategies: Positive & Logical thinking; Speaking: Essentials Nuances & Modes of Speech Delivery.

Module2-ComponentsofTechnical Writing [08]

Vocabulary Building: Select words; Concept of word formation; Word formation; Root words from foreign languages & their use in English; Prefixes & Suffixes: Derivatives; Synonyms; Antonyms; Abbreviations. Homophones. One word substitutes; Requisites of Sentences.

Module3-BasicTechnicalWritingSkills [08]

Forms: Business writing: Principle; Purchase & Sales Letters; Drafts; Official Writing: Official Letter; D.O. Letter;Notices;Agenda;MinutesofMeeting;SentenceStructure;Phrases&Clausesinsentences;Coherence; Unity; Emphasis in Writing; Devices; Use of Writing methods in Documents; Techniques of writing.

Module4-CommonGrammaticalErrors&TechnicalStyle [08]

Subject-verb agreement; Correct usage: Noun; Pronoun; Agreement; Modifiers; Articles; Prepositions; Cliches; Redundancies; Technical Style: Features; Choice of words; Sentences: Descriptive; Narrative; Expository; Defining & Classifying; Length of paragraph; Writing of Introduction & Conclusion.

Module5-PresentationStrategies&OralCommunications [08]

Analysis of locale; Audience; Modulating Style & Content; Speaking with confidence; Kinesics;Paralinguistic features of Voice-Dynamics: Pitch; Intonation; Stress & Rhythm; Conversation & dialogues; Communication at work-place; etc.

CourseOutcomes

1. Studentswillbeenabledtounderstandthebasicobjectiveofthecoursebybeingacquaintedwithspecific dimensions of communication skills i.e. Reading, Writing, Listening, Thinking and Speaking.
2. Students would be able to create substantial base by the formation of strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading, writing and speaking etc.
3. Students will apply it at their work place for writing purposes such as Presentation/official drafting / administrative communication and use it for document/project/report/research paper writing.
4. Students will be made to evaluate the correct & error-free writing by being well-versed in rules ofEnglish grammar & cultivate relevant technical style of communication & presentation at their work place & also for academic uses.
5. Studentswillapplyitforpracticalandoralpresentationpurposesbybeinghonedupinpresentationskills and voice-dynamics. They will apply techniques for developing inter-personal communication skills and positive attitude leading to their professional competence.

Text Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. ImproveYourWritinged.V.N.AroraandLaxmiChandra,OxfordUniv.Press,2001,NewDelhi.

ReferenceBooks:

1. WordPowerMadeEasybyNormanLewis,W.R.GoyalPub.&Distributors,2009,Delhi.
2. ManualofPracticalCommunicationbyL.U.B.Pandey;A.I.T.B.S.PublicationsIndiaLtd.;Krishan Nagar, 2013, Delhi.
3. EnglishGrammarandUsagebyR.P.Sinha,OxfordUniversityPress,2005,NewDelhi.
4. English Grammar, Composition and Usage by N.K.Agrawal&F.T.Wood, Macmillan India Ltd., New Delhi.
5. EffectiveCommunicationSkill,KulbhusanKumar,RSSalaria,KhannaPublishingHouse
6. EnglishGrammar&CompositionbyWren&Martin,S.Chand&Co.Ltd.,NewDelhi.
7. CommunicationSkillsforEngineersandScientists,SangeetaSharmaet.al.PHILearningPvt.Ltd,2011, New Delhi.
8. PersonalityDevelopment,HaroldR.Wallace&L.AnnMasters,CengageLearning,NewDelhi
9. PersonalityDevelopment&SoftSkills,BarunK.Mitra,OxfordUniversityPress,2012NewDelhi.
10. BusinessCorrespondenceandReportWritingbyProf.R.C.Sharma&KrishnaMohan,TataMcGraw Hill & Co. Ltd., 2001, New Delhi.
11. DevelopingCommunicationSkillsbyKrishnaMohan,MeeraBannerji-MacmillanIndiaLtd.1990,Delhi.
12. SpokenEnglish-AmanualofSpeechandPhoneticsbyR.K.Bansal&J.B.Harrison,Orient Blackswan, 2013, New Delhi.
13. BusinessEnglishbyKenTaylor,OrientBlackswan,2011,NewDelhi.

MECHANICALWORKSHOPLAB

BTME109P

SubjectCode: BTME109P	MechanicalWorkshopLab	LTP:002	Credits:1

_COURSEOBJECTIVES

1. Studentsabletounderstanddifferenttool&equipmentforworkshoppractice.
2. StudentsacquireskillsforthepreparationofdifferentCarpentry/fitting/weldingmodels.
3. Studentsabletounderstandthesafetyprecautionintheworkshop
4. StudentacquiresskillsofApplicationorientatedtasks.

S. No.	MechanicalWorkshop	Duration
	IntroductiontoMechanicalworkshopmaterial,toolsandmachines	
1	To study layout, safety measures and different engineering materials (mild steel,mediumcarbonsteel,highcarbonsteel,highspeedsteelandcastiron etc) used in workshop. To study and use of different types of tools, equipments, devices & machines used in fitting, sheet metal and welding section. To determine the least count of vernier caliper, vernier height gauge, micrometer (Screw gauge) and take different reading over given metallic pieces using these instruments.	**3Hours**
	Machineshop	
2	Demonstration of working, construction and accessories for Lathe machine Perform operations on Lathe - Facing, Plane Turning, step turning, taper turning, threading, knurling and parting.	**3 Hours**
	Fittingshop	
3	1.Practicemarkingoperations. **2.**Preparation of U or V -Shape Male Female Work piece which contains:Filing, Sawing, Drilling, Grinding.	**3Hours**
	Carpentry Shop	
4	Study of Carpentry Tools, Equipment and different joints. Making of CrossHalf lap joint, Half lap Dovetail joint and Mortise Tension Joint	**3Hours**
	WeldingShop	
5	IntroductiontoBIstandardsandreadingofweldingdrawings.	

CourseOutcomes

a. Usevariousengineeringmaterials,tools,machinesandmeasuringequipments.

b. PerformmachineoperationsinlatheandCNCmachine.

c. Performmanufacturingoperationsoncomponentsinfittingandcarpentry shop.
d. Performoperationsinwelding,moulding,castingandgascutting.
e. Fabricateajobby3Dprintingmanufacturing technique

SEMESTERII

FundamentalofMechanicalEngineeringandMechatronics
BTME201

SubjectCode: BTME201	**FundamentalofMechanicalEngineering and Mechatronics**	**LTP:300**	**Credits:3**

Courseobjectives

1GainfundamentalknowledgeofThermodynamics,FluidMechanicsandI.C.Engines.

2.Developskillsformaterialselectionfordifferentdevices/components

Unit	Topics	Lectures
I	**Unit I: Introduction to Mechanics of Solid:** NormalandshearStress,strain,Hookes'law,Poisson'sratio,elasticconstants andtheirrelationship,stress-straindiagramforductileandbrittlematerials, factorof safety.BasicNumericalproblems.Types ofbeamsunder variousloads, StaticallyDeterminateBeams,Shearforceandbendingmomentinbeams,Shear force and bending moment diagrams, Relationships between load, shear and bending moment. Basic Numerical problems.	8
II	**IntroductiontoICEnginesandRAC:** **IC Engine:** Basic Components, Construction and Working of Two stroke and four stroke SI & CI engine, merits and demerits, scavenging process; Introduction to electric, and hybrid electric vehicles. **Refrigeration:**Itsmeaningandapplication,unitofrefrigeration;Coefficient ofperformance,methodsofrefrigeration,constructionandworkingofdomestic refrigerator,conceptofheatpump.Formulabasednumericalproblemsoncooling load. **Air-Conditioning:** Its meaning and application, humidity, dry bulb, wet bulb, and dew point temperatures, comfort conditions, construction and working of window air conditioner.	10
III	**IntroductiontoFluidMechanicsandApplications:** **Introduction:** Introduction: Fluids properties, pressure, density, dynamic and kinematic viscosity, specific gravity, Newtonian and Non-Newtonian fluid, Pascal's Law, Continuity Equation, Bernaulli's Equation and its applications, Basic Numerical problems. Working principles of hydraulic turbines & pumps andtheirclassifications,hydraulicaccumulators,hydraulicliftandtheir	7

	applications.	
IV	**Measurements and Control System:** Concept of Measurement, Error in measurements, Calibration, measurements of pressure, temperature, mass flow rate,strain,forceandtorques;Conceptofaccuracy,precisionandresolution, BasicNumericalproblems.SystemofGeometricLimit,Fit,Toleranceand gauges,BasicNumericalproblems.	8
V	**Control System Concepts:** Introduction to Control Systems, Elements of control system, Basic of open and closed loop control with example. **Introduction to Mechatronics:** Evolution, Scope, Advantages and disadvantages of Mechatronics, Industrial applications of Mechatronics, Introductiontoautotronics,bionics,andavionicsandtheirapplications.Sensors and Transducers: Types of sensors, types of transducers and theircharacteristics. **OverviewofMechanicalActuationSystem**–KinematicChains,Cam,Train RatchetMechanism,Gearsanditstype,Belt,Bearing. **Hydraulic and Pneumatic Actuation Systems:** Overview: Pressure Control Valves, Cylinders, Direction Control Valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems.	10

CourseOutcomes:

CourseOutcomes(COs)	Description
CO1	Studentwillunderstandbasicofstress,strainandshearforcebending moment diagram concept.
CO2	Studentwilllearntheworkingofengineandrefrigeration.
CO3	Studentwilllearntheimplementationofbernoulli'stheoremandpascal's law.
CO4	Studentwilllearnaboutmeasurementssystemandcontrol system.
CO5	StudentwillunderstandkeyelementsofMechatronicssystem, representation into block diagram.

ReferenceBooks:

1 BasicMechanicalEngineering,GShanmugam,SRavindran,McGraw Hill
2 BasicMechanicalEngineering,MPPooniaandSCSharma,KhannaPublishers
3 Mechatronics:Principles,ConceptsandApplications,NitaigourMahalik,McGraw Hill

4 Mechatronics,AsperAICTE:IntegratedMechanicalElectronicSystems,K.P. Ramachandran, G.K. Vijayaraghavan, M.S.Balasundaram, Wiley India
5 MechanicalMeasurements&Control,Dr.D.S.Kumar.MetropolitanBookCompany
6 FluidMechanicsandHydraulicMachines,MaheshKumar,PearsonIndia

BasicElectricalEngineeringBTME202

SubjectCode: BTME202	BasicElectrical Engineering	LTP:300	Credits:3

Courseobjectives

Understand the basic definitions of electro- magnetic terminologies, concepts of Inductor and analysis.
Understandtheworking,featuresandclassificationoftransformer,DCandACmachines,problemsolving.

Understand the basic passive components, features, specifications, classification and applications.

Module- 1:DC Circuits [08]

Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Superposition theorem, Thevenin theorem, Norton theorem.

Module - 2: Steady- State Analysis of Single Phase AC Circuits [08]

Representation of Sinusoidal waveforms – Average and effective values, Form and peak factors, Concept of phasors,phasorrepresentationofsinusoidallyvaryingvoltageandcurrent.AnalysisofsinglephaseAC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power,Powerfactor,powerfactorimprovement.ConceptofResonanceinseries&parallelcircuits, bandwidthandqualityfactor.Threephasebalancedcircuits,voltageandcurrentrelationsinstaranddelta connections.

Module- 3:Transformers [08]

Magneticmaterials,BHcharacteristics,idealandpracticaltransformer,equivalentcircuit,lossesin transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module–4:Electricalmachines [08]

DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor,applications of DC motors (simple numerical problems)

ThreePhaseInductionMotor: Principle&Construction,Types,Slip-torquecharacteristics,Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Module–5:ElectricalInstallations [06]

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries.Elementary calculations for energy consumption and savings, battery backup.

SpokenTutorial(MOOCs):

1. ACDCCircuitAnalysisusingNgSpice,OpenSourceSoftware(http://spoken-tutorial.org)

CourseOutcomes

1. ApplytheconceptsofKVL/KCL andnetworktheoremsinsolvingDC circuits.
2. Analyzethesteadystatebehaviorofsinglephaseandthreephase ACelectricalcircuits.
3. Identify the application areas of a single phase two winding transformer as well as an auto transformer and calculate their efficiency. Also identify the connections of a three phase transformer.
4. Illustrate the working principles of induction motor, synchronous machine as well as DC machine and employ them in different area of applications.
5. Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Text Books:

1. RituSahdev,"BasicElectricalEngineering",KhannaPublishingHouse.
2. S.Singh,P.V.Prasad,"ElectricalEngineering:ConceptsandApplications"Cengage.
3. D.P.KothariandI.J.Nagrath,"BasicElectricalEngineering",TataMcGrawHill.
4. D.C.Kulshreshtha,"BasicElectricalEngineering",McGrawHill.

ReferenceBooks:

1. E.Hughes,"ElectricalandElectronicsTechnology",Pearson,2010.
2. L.S.Bobrow,"FundamentalsofElectricalEngineering",OxfordUniversityPress.
3. V.D.Toro,"ElectricalEngineeringFundamentals",PearsonIndia.

BasicElectricalEngineering-LabBTME207P

SubjectCode: BTME207P	BasicElectricalEngineering-Lab	LTP:002	Credits:1

Courseobjectives

The main objective ofthe laboratory is to develop thepracticalexperience ofthe first-yearstudents, practiceandapplylaboratoryexperiments,connect,examineandanalyzetheelectricalcircuits,and obtain the required results to prepare a report on the experiment

ListOfExperiments

Note:Aminimumof8experimentsfromthefollowingshouldbeperformed.

1. VerificationofKirchhoff's laws
2. VerificationofSuperpositionandTheveninTheorem.
3. Measurementofpowerandpowerfactorinasingle-phaseacseriesinductivecircuitandstudy improvement of power factor using capacitor
4. StudyofphenomenonofresonanceinRLCseriescircuitandobtainresonantfrequency.
5. Connectionandmeasurementofpowerconsumptionofafluorescentlamp(tubelight).
6. Measurementofpowerin3-phasecircuitbytwowattmetermethodanddeterminationofitspowerfactor for star as well as delta connected load.
7. DeterminationofparametersofacsinglephaseseriesRLCcircuit
8. ToobservetheB-HloopofaferromagneticmaterialinCRO.
9. Determinationof(i)Voltageratio(ii)polarityand(iii)efficiencybyloadtestofasinglephasetransformer.
10. Determinationofefficiencyofadcshuntmotorbyload test
11. Tostudyrunningandspeedreversalofathree-phaseinductionmotorandrecordspeedinbothdirections.
12. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

CourseOutcomes

1. ConductexperimentsillustratingtheapplicationofKVL/KCLandnetworktheoremstoDCelectrical circuits.
2. DemonstratethebehaviorofACcircuitsconnectedtosinglephaseACsupplyandmeasurepowerin single phase as well as three phase electrical circuits.
3. PerformexperimentillustratingBHcurveofmagneticmaterials.
4. CalculateefficiencyofasinglephasetransformerandDC machine.
5. Perform experiments on speed measurement and reversal of direction of three phase induction motor and Identify the type of DC and AC machines based on their construction.

EngineeringPhysics
BTME203

SubjectCode: BTME203	**EngineeringPhysics**	**LTP:300**	**Credits:3**

Courseobjectives

It provides sensible preparation for other areas of engineering, including mechanical, electrical, civil engineeringandcomputerscience.Itprovidesabroadfoundationinthebasicsofscienceandengineering

Module-1Relativistic Mechanics: [8]
Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morleyexperiment,Postulatesofspecialtheoryofrelativity,Lorentztransformations, Lengthcontraction, Timedilation,Velocityadditiontheorem,Variationofmasswith velocity,Einstein‟s massenergy relation, Relativisticrelation between energy and momentum, Massless particle.

Module-2ElectromagneticField Theory: [8]
Continuity equation for current density, Displacement current, Modifying equation for the curl of magnetic field to satisfy continuity equation, Maxwell‟sequations invacuumandin non conducting medium, Energy in an electromagnetic field, Poynting vector and Poynting theorem, Plane electromagnetic waves in vacuum and their transverse nature. Relation between electric and magnetic fields of an electromagnetic wave, Energy and momentum carried by electromagnetic waves, Resultant pressure, Skin depth.

Module-3QuantumMechanics: [8]
Blackbodyradiation,Stefan‟slaw,Wien‟slaw,Rayleigh-JeanslawandPlanck‟slaw,Wave particle duality, Matter waves, Time-dependent and time-independent Schrodinger wave equation,Born interpretationofwavefunction,SolutiontostationarystateSchrodinger wave equation for one- Dimensional particle in a box,Compton effect.

Module-4Wave Optics: [10]
Coherentsources,Interferenceinuniformandwedgeshapedthinfilms,Necessityof extended sources,Newton‟s Ringsanditsapplications.Fraunhofferdiffractionatsingleslit andatdouble slit, absent spectra, Diffraction grating, Spectra with grating, Dispersivepower, Resolvingpower of grating,Rayleigh‟scriterionofresolution,Resolvingpowerof grating.

Module-5FibreOptics& Laser: [10]
FibreOptics**:**Introductiontofibreoptics,Acceptanceangle,Numericalaperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres. Laser: Absorption of radiation,Spontaneousandstimulatedemissionofradiation,Einstein‟scoefficients,Population inversion,Variouslevels ofLaser,RubyLaser, He-Ne Laser,Laser applications.

Course Outcomes:

1. Tosolve theclassicalandwave mechanicsproblems

2. Todevelop theunderstanding oflaws ofthermodynamics andtheir application in various processes
3. Toformulateandsolvetheengineeringproblemson Electromagnetism&Electromagnetic FieldTheory
4. Toawareoflimitsofclassicalphysics&toapplytheideasinsolvingtheproblemsintheirparent streams

Reference Books:

1. Concepts ofModernPhysics -AurthurBeiser(Mc-Graw Hill)
2. IntroductiontoSpecialTheoryofRelativity-RobertResnick(Wiley)
3. Optics-Brijlal&Subramanian(S.Chand)
4. EngineeringPhysics: TheoryandPractical-Katiyarand Pandey(Wiley India)
5. AppliedPhysicsforEngineers-Neeraj Mehta(PHILearning,New)
6. Engineering Physics-Malik HKand SinghAK (McGrawHill)

EngineeringPhysicsLabBTM E206P

SubjectCode: BTME206P	EngineeringPhysics Lab	LTP:002	Credits:1

CourseObjective:

Thiscourseisdesigned(i)Toimpartpracticalknowledgeaboutsomepracticalphenomenatheyhave studied in the engineering physics course and (ii) To develop the experimental skills of the students.

ListofExperiments

Anyten experiments

1. Todeterminethewavelengthofsodiumlight byNewton‟sringexperiment.

2. Todeterminethewavelengthofdifferentspectrallinesofmercurylightusingplanetransmission grating.

2. Tomeasureattenuationinanopticalfiber.
3. TodeterminethewavelengthofHe-Nelaserlightusingsingleslitdiffraction.
4. Todeterminethewavelengthofsodium lightwiththehelpofFresnel‟sbi-prism.
5. Todeterminethecoefficientofviscosityofagiven liquid.

6. Todeterminethevalueofaccelerationduetogravity(g)usingcompoundpendulum.
8. Todeterminetheenergybandgapofagivensemiconductormaterial.

9. TostudyHalleffectanddetermineHallcoefficient,carrierdensityandmobilityofagiven semiconductor material using Hall effect setup.

10. Todeterminethevariationofmagneticfieldwiththedistancealongtheaxisofacurrent carrying coil and estimate the radius of the coil.

11. Tostudytheresonanceconditionofaseries LCR circuit.

12. Todrawhysteresis(B-Hcurve)ofaspecimenintheformofatransformerandtodetermineits hysteresis loss.

ReferenceBooks

1. PracticalPhysics-K.K.Dey&B.N.Dutta(KalyaniPublishersNewDelhi)
2. EngineeringPhysics-TheoryandPractical-Katiyar&Pandey(WileyIndia)
3. EngineeringPhysicsPractical-SKGupta(KrishnaPrakashanMeerut)

CourseOutcomes:

1Todeterminethewavelengthofsodiumlightby Newton‟sringexperiment
2 Todeterminethewavelengthofsodiumlightwiththehelpof Fresnel‟sbi-prism
3 Todeterminethevariationofmagneticfieldwiththedistancealongtheaxisofacurrent carrying coil and estimate the radius of the coil.

4 To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresisloss.

EngineeringMathematics-II
BTME204

SubjectCode: BTME204	**EngineeringMathematics-II**	**LTP:300**	**Credits:3**

CourseObjective:

1) Evaluatederivativesforcomplexlyconstructedelementaryfunctions;
2) Evaluatedefiniteandindefiniteintegrals;and
3) Evaluatelimitsusingalgebraic,geometric,analytic techniques.
4) Correctlyincorporatespecificexamples

Module 1: Ordinary Differential Equation of Higher Order **[10]** Linear differential equation of n^{th} order with constant coefficients, Simultaneous linear differential equations, Second order linear differential equations with variable coefficients, Solution by changing independent variable, Reduction of order, Normal form, Method of variation of parameters, Cauchy-Euler equation, Series solutions (Frobenius Method).

Module2:MultivariableCalculus-II **[08]**
Improper integrals, Beta & Gama function and their properties, Dirichlet's integral and its applications, Application of definite integrals to evaluate surface areas and volume of revolutions.

Module3:Sequencesand Series **[08]**
Definition of Sequence and series with examples, Convergence of sequence and series, Tests for convergence of series, (Ratio test, D' Alembert's test, Raabe's test). Fourier series, Half range Fourier sine and cosine series.

Module4:ComplexVariable–Differentiation [08]

Limit, Continuity and differentiability, Functions of complex variable, Analytic functions, Cauchy- Riemann equations (Cartesian and Polar form), Harmonic function, Method to find Analytic functions, Conformal mapping, Mobius transformation and their properties

Module-5ComplexVariables– Integration [08]

Complex integrals, Contour integrals, Cauchy- Goursat theorem, Cauchy integral formula, Taylor's series, Laurent's series, Liouvilles's theorem, Singularities, Classification of Singularities, zeros of analyticfunctions, Residues, Methods of finding residues, Cauchy Residue theorem, Evaluation of real integral of the type $\int_0^{2\pi} f(\cos\theta, \sin\theta)\,d\theta$ and $\int_{-\infty}^{\infty} f(x)\,dx$.

CourseOutcomes

1. Understandtheconceptofdifferentiationandapplyforsolvingdifferentialequations.
2. Remembertheconceptofdefiniteintegralandapplyforevaluatingsurfaceareasandvolumes.
3. Understandtheconceptofconvergenceofsequenceandseries.AlsoevaluateFourierseries
4. Illustratetheworkingmethodsofcomplexfunctionsandapplyforfindinganalyticfunctions.
5. Apply the complex functions for finding Taylor's series, Laurent's series and evaluation of definiteintegrals

Text Books:-

1. B.V.Ramana,HigherEngineeringMathematics,TataMcGraw-HillPublishingCompanyLtd.,2008.
2. B.S.Grewal,HigherEngineeringMathematics,KhannaPublisher,2005.
3. R.K.Jain&S.R.K.Iyenger,AdvanceEngineeringMathematics,NarosaPublishing-House,2002.

ReferenceBooks:-

1. E.Kreyszig,AdvanceEngineeringMathematics,JohnWiley&Sons, 2005.
2. PeterV.O'Neil,AdvanceEngineeringMathematics,Thomson(Cengage)Learning,2007.
3. MauriceD.Weir,JoelHass,FrankR.Giordano,Thomas,Calculus,EleventhEdition,Pearson.
4. G.BThomas,RLFinney,CalculusandAnalyticalGeometry,NinthEditionPearson,2002.
5. James Ward Brown and Ruel V Churchill, Fourier Series and Boundary Value Problems, 8th Edition-Tata McGraw-Hill
6. D.Poole,LinearAlgebra:AModernIntroduction,2ndEdition,Brooks/Cole,2005.
7. VeerarajanT.,EngineeringMathematicsforfirstyear,TataMcGraw-Hill,NewDelhi, 2008.
8. Charles E Roberts Jr, Ordinary Diffrential Equations, Application, Model and Computing, CRC Press T&F Group.
9. RayWylieCandLouisCBarret,AdvancedEngineeringMathematics,6thEdition,TataMcGraw-Hill.
10. JamesWardBrownandRuelVChurchill,ComplexVariableandApplications,8thEdition,Tata McGraw-Hill.
11. P. Sivaramakrishna Das and C. Vijayakumari, Engineering Mathematics, 1st Edition, Pearson IndiaEducation Services Pvt. Ltd.
12. AdvancedEngineeringMathematicsByChandrikaPrasad,ReenaGargKhannaPublishingHouse, Delhi

ArtificialIntelligenceforEngineers

(BTME205)

SubjectCode: BTME205	ArtificialIntelligenceforEngineers	LTP:200	Credits:2

Courseobjectives

Themainlearningobjectivesofthecourseareto:Identifyproblemswhereartificialintelligence techniques are applicable.

ApplyselectedbasicAItechniques;judgeapplicabilityofmoreadvanced techniques

Course	Topics
Unit1	**AnoverviewtoAI**
	TheevolutionofAItothepresent
	VariousapproachestoAI
	WhatshouldallengineersknowaboutAI?
	Otheremergingtechnologies
	AIandethical concerns
Unit2	**Data&Algorithms**
	HistoryOfData
	DataStorageAndImportanceofDataandits Acquisition
	TheStagesofdataprocessing
	DataVisualization
	Regression,Prediction&Classification
	Clustering&RecommenderSystems
Unit3	**NaturalLanguageProcessing**
	Speechrecognition
	Naturallanguageunderstanding
	Naturallanguagegeneration
	Chatbots
	MachineTranslation

Unit4 **ArtificialNeuralNetworks**

DeepLearning

RecurrentNeuralNetworks

ConvolutionalNeuralNetworks

TheUniversalApproximationTheorem

GenerativeAdversarialNetworks

Unit5 **Applications**

Imageandfacerecognition

Objectrecognition

SpeechRecognitionbesidesComputerVision

Robots

Applications

CourseOutcomes

1. Understandtheevolutionandvariousapproachesof AI
2. Understanddatastorage,processing,visualization,anditsuseinregression,clusteringetc.
3. Understandnaturallanguageprocessingandchatbots
4. Understandtheconceptsofneural networks.
5. Understandtheconceptsofface,object,speechrecognitionandrobots.

ReferenceBooks:

1. ArtificialIntelligence:AModernApproachbyStuartRussellandPeterNorvig,Prentice Hall
2. ArtificialIntelligencebyKevinKnight,ElaineRich,ShivashankarB.Nair,Publisher:McGrawHill
3. DataMining:ConceptsandTechniquesbyJiaweiHan,MichelineKamber,JianPei, Publisher: Elsevier Science.
4. Speech&LanguageProcessingbyDanJurafsky,Publisher:PearsonEducation
5. NeuralNetworksandDeepLearningATextbookbyCharuC.Aggarwal,Publisher:Springer International Publishing
6. IntroductiontoArtificialIntelligenceByRajendraAkerkar,Publisher:PHILearning

EnglishLanguageLabBTME 208P

SubjectCode: BTME208P	**EnglishLanguageLab**	**LTP:002**	**Credits:1**

CourseObjectives:

(i) TofacilitatesoftwarebasedlearningtoprovidetherequiredEnglishLanguageproficiencyto students.

(ii) Toacquaintstudentswithspecificdimensionsofcommunicationskillsi.e.Reading,Writing, Listening, Thinking and Speaking.

(iii) To train students to use the correct and error-free writing by being well versed in rules of Englishgrammar.

(iv) To cultivate relevant technical style of communication and presentation at their work place and also for academic uses.

(v) Toenablestudentstoapplyitforpracticalandoralpresentationpurposesbybeinghonedupin presentation skills and voice-dynamics.

SYLLABUS:PROFESSIONALCOMMUNICATIONLABSHALLHAVETWOPARTS:
Interactive and Communicative Practical with emphasis on Oral Presentation/Spoken Communication based on International Phonetic Alphabets (LP.A.)

ListofPracticals

1. GroupDiscussion:PracticalbasedonAccurateandCurrentGrammatical Patterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. CommunicationSkillsforSeminars/Conferences/WorkshopswithemphasisonParalinguistic /Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
5. Official/PublicSpeakingbasedonsuitableRhythmicPatterns.
6. ThemePresentation/KeynotePresentationbasedoncorrectmethodologiesargumentation.
7. IndividualSpeechDelivery/ConferencingwithskillstodefendInterjections/Quizzes.
8. ArgumentativeSkills/RolePlayPresentationwithStressandIntonation.
9. ComprehensionSkillsbasedonReadingandListeningPractical'sonamodelAudio.

1. **Computer assisted software based Language Learning:** Software based self-guided learning to provide the required English language proficiency to students from an employability and career readiness standpoint. The software should align to Common European Framework of Reference for Languages (CEFR) and deliver a CEFR level – B2 upon completion.
2. **Interactive Communication Skills:** Students should practice the language with variety of activities and exercises based on employability skills as startup presentations, GD, Mock interview, Video portfolio, Extempore, Role play, Just A Minute (JAM) etc.

Suggestedsoftware:

1. **OxfordAchiever**byOxfordUniversity Press.
2. **CambridgeEnglishEmpower**byCambridgeUniversityPress.
3. **MePro.**byPearsonIndiaEducationServicesPvt.Ltd.
4. **NewInteractions**byMcGraw-Hill India.

CO1:Identifycommonerrorsinspokenandwritten communication.
CO2:GetfamiliarizedwithEnglishvocabularyandlanguageproficiency.
CO3:Improvenatureandstyleofsensiblewriting,acquireemploymentandworkplace communication skills.

CO4:ImprovetheirTechnicalCommunicationSkillsthroughTechnicalReadingandWriting practices.

CO5:Performwellincampusrecruitment,engineeringandallothergeneralcompetitive examinations.

ReferenceBooks:

1. WordPowerMadeEasybyNormanLewis,W.R.GoyalPub.&Distributors,2009,Delhi.
2. Manual of Practical Communication by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; KrishanNagar, 2013, Delhi.
3. ACourseinPhoneticsandSpokenEnglish,Sethi&Dhamija:,PrenticeHall
4. EnglishPronouncingDictionary,JoansDaniel,CambridgeUniversityPress,2007.
5. EnglishGrammarandUsagebyR.P.Sinha,OxfordUniversityPress,2005,NewDelhi.
6. EnglishGrammar,CompositionandUsagebyN.K.Agrawal&F.T.Wood,MacmillanIndiaLtd., New Delhi.
7. EffectiveCommunicationSkill,KulbhusanKumar,RSSalaria,KhannaPublishingHouse
8. EnglishGrammar&CompositionbyWren&Martin,S.Chand&Co.Ltd.,NewDelhi.
9. CommunicationSkillsforEngineers andScientists, SangeetaSharmaet.al.PHILearning Pvt.Ltd, 2011, New Delhi.
10. PersonalityDevelopment,HaroldR.Wallace&L.AnnMasters,CengageLearning,NewDelhi
11. PersonalityDevelopment&SoftSkills,BarunK.Mitra,OxfordUniversityPress,2012NewDelhi.

EngineeringGraphicsandDesign-Lab(BTME209P)

SubjectCode: BTME209P	EngineeringGraphicsandDesign-Lab	LTP:002	Credits:1

CourseObjectives

- Instructtheutilityofdrafting&modelingpackagesinorthographicandisometricdrawings.
- Traintheusageof2Dand3Dmodeling.
- Instructgraphicalrepresentationofmachinecomponents.

Module 1: Introduction to Engineering Drawing, Orthographic Projections [08]

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales

PrinciplesofOrthographicProjections–Conventions–ProjectionsofPointsandLinesinclinedtoboth planes; Projections of planes inclined Planes – Auxiliary Planes.

Module 2: Projections and Sections of Regular Solids

[08]Sections inlinedtobothePlanes–AuxiliaryViews;Simpleannotation,dimensioningandscale.Floor plans the include: windows, doors and fixtures such as WC, Both, sink, shower, etc.

Prism, Cylinder, Pyramid, Cone – Auxiliary Vies: Development of surfaces of Right Regular Solids – Prism, Pyramid, Cylinder and Cone.

Module3:IsometricProjections [08]

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.

Module4:Computer Graphics [08]

Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modifyand Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];

Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits;ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles:

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to pater using the print command: orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies.Parametricandnon-parametricsolid,surface,andwireframemodels.Parteditingandtwo-

dimensional documentationofmodels. Planar projectiontheory,includingsketchingof perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.

Module 5: Demonstration of a simple team design project [08]

Geometry and topology of engineered components: creation of engineering models and their presentation in standard2Dblueprintformandas3Dwire-frameandshadedsolids;meshedtopologiesforengineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Useof solid-modelling software for creating associative models at the component and assembly levels; floor plans thatinclude:windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applyingcolourcoding accordingtobuildingdrawingpractice;Drawingsectionalelevationshowingfoundationtoceiling; Introduction to Building Information Modelling (BIM).

CourseOutcomes

1: Understandingofthevisualaspectsofengineeringdesign
2: Understandingofengineeringgraphicsstandardsandsolidmodelling 3: Effective communication through graphics
4: Applyingmodernengineeringtoolsnecessaryforengineeringpractice 5: Appling computer-aided geometric design
6: AnalysisofIsometricviews
7: Creating working drawings

SuggestedText/ReferenceBooks:

(i) BhattN.D.,PanchalV.M.&InglеP.R.(2014),EngineeringDrawing,CharotarPublishingHouse.
(ii) Shah,M.B.&RanaB.C.(2008),EngineeringDrawingandComputerGraphics,PearsonEducation
(iii) AgrawalB.&AgrawalC.M.(2012),EngineeringGraphics,TMHPublication
(iv) EngineeringGraphics&Design,A.P.Gautam&PradeepJain,KhannaPublishingHouse
(v) Narayana,K.L.&PKannaiah(2008),TextbookonEngineeringDrawing,ScitechPublishers.
(Corresponding set of) CAD Software Theory and User Manuals

SEMESTERIII

BTME301–Mathematics-III(PDE,ProbabilityandStatistics)

SubjectCode: BTME301	BTME301–Mathematics-III	LTP:300	Credits:3

CourseObjectives

The objective of this course is to familiarize the students with partial differential equation, their application andstatistical techniques. Itaimstopresentthe students with standard concepts and tools at an intermediateto superior level that willprovidethemwelltowardsundertakingavariety ofproblemsinthe discipline.

Thestudentswilllearn:

- Theideaofpartialdifferentiationandtypesofpartialdifferentialequations
- Theideaof classificationofsecondpartialdifferentialequations,wave,heatequationand transmission lines
- The basic ideas of statistics including measures of central tendency, correlation, regression and their properties.
- Theideasofprobabilityandrandomvariablesandvariousdiscreteandcontinuousprobability distributions and their properties.
- Thestatisticalmethodsofstudyingdatasamples,hypothesistestingandstatisticalqualitycontrol, control charts and their properties.

ModuleI:PartialDifferentialEquations

Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order,Lagrange's Equations, Charpit's method, Cauchy's method of Characteristics, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.

ModuleII:ApplicationsofPartialDifferentialEquations:

Classificationoflinearpartialdifferentialequationofsecondorder,Methodofseparationof variables,Solutionofwaveandheatconductionequationuptotwodimension,Laplaceequationin two dimensions, Equations of Transmission lines.

ModuleIII:StatisticalTechniquesI:

Introduction:Measuresof central tendency,Moments,Momentgenerating function (MGF) , Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves ,Correlation and Rank correlation,Regression Analysis: Regressionlinesofy onxand xony,regressioncoefficients,propertiesofregressions coefficients and non linear regression.

ModuleIV:StatisticalTechniquesII:

Probability and Distribution: Introduction, Addition and multiplication law of probability, Conditional probability, Baye's theorem, Random variables (Discrete and Continuous Randomvariable) Probability mass function and Probability density function, Expectation and variance,Discrete and Continuous Probability distribution: Binomial, Poission and Normal distributions.

ModuleV:StatisticalTechniquesIII:

Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , Sampling Theory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis,Levelof significance, Confidence limits, Test of significance of difference of means, T-test,F-test and Chi-squaretest,OnewayAnalysisofVariance(ANOVA).StatisticalQuality

Control (SQC), Control Charts , Control Charts for variables ($\overline{X}$and R Charts), Control Charts for Variables (p, np and C charts).

TextBooks

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
3. S.Ross:AFirstCourseinProbability,6thEd.,PearsonEducationIndia,2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

ReferenceBooks

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
2.T.Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.
3. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing House, New Delhi.
4. J.N.Kapur:MathematicalStatistics;S.Chand&SonsCompanyLimited,NewDelhi.
5. D.N.Elhance,V. Elhance & B.M. Aggarwal: Fundamentals of Statistics; Kitab Mahal Distributers, New Delhi.

CourseOutcomes (COs)	Description
CO1	Studentsareabletosolvelinearandnon-linearpartialdifferentialequations used in engineering and technology.
CO2	Studentscanapplythemethodofseparationofvariabletosolvethe partial differential equations like, Laplace, Heat, Wave, Radio.
CO3	Statistical tools like Measure of central tendency, correlation and regression can help the students in recognizing the better data related to the engineering field.

CO4	Using theprobabilityand variousdistributions,students cansolvethe industrial as well as real life problems.
CO5	Withthehelpofstatisticalqualitycontroltechniques,studentscan analyze the defectiveness of product produced in the manufacture firm.

Evaluationmethodologytobefollowed:

Theevaluationandassessmentplanconsistsof thefollowingcomponents:

a.Class attendance and participation in class discussions etc.b. Quiz.
c.Tutorials andassignments.d. Sessional
examination.
e.Finalexamination.

AwardofInternal/ExternalMarks:

Assessmentprocedurewillbeasfollows:

1. Thesewillbecomprehensiveexaminationsheldon-campus(Sessionals).
2. Quiz.
   a. Quiz will be of type multiple choice, fill-in-the-blanks or match the columns.b. Quiz will be held periodically.
3. Tutorialsandassignments
   a. Theassignments/home-workmaybeofmultiplechoicetypeorcomprehensivetypeat least one assignment from each Module/Unit.
   b. The grades and detailed solutions of assignments(of both types) will be accessible online after the submission deadline.
4. Finalexaminations.

TechnicalCommunication

(BTME302)

SubjectCode: BTME302	TechnicalCommunication	LTP:300	Credits:3

Courseobjective:

- Toprovideyouwiththeconfidencetousewrittencommunicationinyourworkandpersonalexperience beyond college,
- Toacquaintyouwiththeconceptofawriter-readerrelationshipandidentifytheneedforactive participation from both writer and reader,
- Toteachyoutheskillsneededtosuccessfullycommunicateinamodernworldthroughwritten materials.

Unit-1Fundamentalsof Technical Communication:

TechnicalCommunication: Features;DistinctionbetweenGeneralandTechnicalCommunication; LanguageasatoolofCommunication

DimensionsofCommunication: Reading & comprehension; Technical writing: sentences; Paragraph

Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral orHorizontal; Barriers to Communication.

Unit-II FormsofTechnical Communication:

TechnicalReport: Definition&importance;

Thesis/Projectwriting:structure&importance;synopsis writing:Methods

Technical research Paper writing: Methods & style; Seminar & Conference paper writing; **Key-Note Speech:** Introduction & Summarization; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.

Unit-IIITechnicalPresentation:Strategies&Techniques

Presentation: Forms;interpersonalCommunication;Classroompresentation;style;method;

Individualconferencing:essentials:PublicSpeaking:method;Techniques:Clarity ofsubstance;emotion; Humour;ModesofPresentation;

OvercomingStageFear: Confidentspeaking;AudienceAnalysis&retention of audience interest

Methodsof Presentation:Interpersonal;Impersonal;AudienceParticipation:Quizzes& Interjections.

Unit-IVTechnicalCommunication Skills:

Interviewskills,GroupDiscussion: Objective&Method;Seminar/ConferencesPresentation

skills: Focus;Content;Style;Argumentationskills;Devices;Analysis;Cohesion&Emphasis;Criticalthinking;

Nuances: Exposition narration & Description; effective businesscommunicationcompetence; Grammatical;

Discoursecompetence:combination ofexpression & conclusion;

Socio-linguisticcompetence: Strategiccompetence:Solutionofcommunicationproblemswithverbaland non verbal means.

Unit-VKinesics &Voice Dynamics:

Kinesics: Definitions;importance;FeaturesofBodyLanguage;VoiceModulation:Quality,Pitch; Rhythm; intonation; Pronunciation; Articulation; stress & accent

Linguisticfeaturesofvoicecontrol: Vowel&Consonant Sounds.

CourseOutcomes(COs)	Description
CO1	Studentswillbeenabledtounderstandthenatureand objectiveofTechnicalCommunicationrelevantforthe work

	placeas Engineers.
CO2	Studentswillutilizethetechnicalwritingforthepurposesof Technical Communication and its exposure in various dimensions.
CO3	Studentswouldimbibeinputsbypresentationskillsto enhance confidence in face of diverse audience.
CO4	Technicalcommunicationskillswillcreateavastknow-how of the application of the learning to promote their technical competence.
CO5	Itwouldenablethemtoevaluatetheirefficacyasfluent& efficient communicators by learning the voice-dynamics.

ReferenceBooks

1. TechnicalCommunication–PrinciplesandPracticesbyMeenakshiRaman&Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. BusinessCorrespondenceandReportWritingbyProf.R.C.Sharma&KrishnaMohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
4. ModernTechnicalWritingbySherman,TheodoreA(et.al);ApprenticeHall;NewJersey;U.S.
5. ATextBookofScientificandTechnicalWritingbyS.D.Sharma;VikasPublication, Delhi.
6. SkillsforEffectiveBusinessCommunicationbyMichaelMurphy,HarwardUniversity, U.S.
7. BusinessCommunicationforManagersbyPayalMehra,Pearson Publication, Delhi

THERMODYNAMICS
(BTME303)

SubjectCode: BTME303	THERMODYNAMICS	LTP:310	Credits:4

Objectives:

- Tolearnaboutworkandheatinteractions,andbalanceofenergybetweensystemanditssurroundings.
- TolearnaboutapplicationofIlawtovarious energy conversion devices.
- Toevaluatethechanges inpropertiesofsubstances invarious processes.
- To understand the difference between high grade and low-grade energies and II lawlimitationson energy conversion.

UNITI

Review of Fundamental Concepts and Definitions: Introduction- Basic Concepts: System, ControlVolume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopicviewpoints,ConceptofContinuum,ThermodynamicEquilibrium,State,Property,Process, Exact&InexactDifferentials,CycleReversibility Quasi–static Process,IrreversibleProcess,Causesof Irreversibility Energy anditsforms,Workandheat(sign convention),Gas laws,Idealgas,Realgas,Law ofcorrespondingstates,Propertyofmixtureofgases,electrical,magnetic,gravitational,springandshaft work. Zeroth law of thermodynamics:Concept of Temperature and its' measurement, Temperature scales. Firstlawofthermodynamics:FirstLawforFlowProcesses - Derivation ofgeneralenergy equation for a controlvolume;Steadystatesteadyflowprocessesincludingthrottling;Examplesofsteadyflow devices;Unsteadyprocesses;examplesofsteadyandunsteadyIlawapplicationsforsystemandcontrol

volume.Limitations of first lawof thermodynamics,PMM-I. Steady flowsystemsandtheiranalysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc.

UNITII

Secondlawofthermodynamics:

Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics,Equivalenceofthetwostatements.Reversibleandirreversibleprocesses,Carnotcycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II. Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNITIII

AvailabilityandIrreversibility: Available and unavailable energy, Availability and Irreversibility, Second lawefficiency,Helmholtz&Gibb'sfunction.Thermodynamicrelations:Conditionsforexact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility.

UNITIV

Properties of steamandRankinecycle: Pure substance, Property of Pure Substance (steam), Triple point, Criticalpoint,Saturation states, Sub- cooledliquidstate,Superheatedvapourstate,Phase transformationprocessofwater,Graphical representationofpressure,volumeandtemperature,P-T, P-VandP-hdiagrams,T-SandH-S diagrams, use of property diagram, Steam-Tables &Moller chart, Dryness factor and it's measurement, processes involving steam in closed and open systems. SimpleRankine cycle. Air-watervapourmixtureandPsychrometry:Psychometrictermsandtheir definitions, Psychometric chart, Different Psychometric processes and their representation on Psychometric chart.

UNITV

RefrigerationCycles:ReversedCarnotCycleforgasandvapour.Refrigerationcapacity,unit ofrefrigeration. Air Refrigeration cycles; Reversed Brayton Cycle and Bell Coleman Cycle. Vapour compression refrigeration cycle; simple saturated cycle and actual vapour compression refrigeration cycle. Analysis of cycles, effect of superheating, sub-cooling and change in evaporator and condenser pressure on performance of vapour compression refrigeration cycle. Refrigerants; their classification and desirable properties. Vapour absorption refrigeration system.

CourseOutcomes:

CourseOutcomes(COs)	Description
CO1	Able to explain the basic concepts of thermodynamics like system, equilibrium, properties, pressure, specific volume, temperature, zeroth law of thermodynamics, temperature measurement and temperature scales. Explain the concept of thermodynamic work. Calculate work different thermodynamic processes or different thermodynamic cycles. Explainthefirstlawofthermodynamicsforclosedandopensystems undergoingdifferentthermodynamicprocesses.
CO2	State and prove the equivalence of two statements of second law of thermodynamics. Define reversible process and state the propositions regardingefficiencyofCarnotcycle.Evaluatethefeasibilityofa thermodynamiccycleusingthesecondlawofthermodynamicsfor typical engineering problems.
CO3	Able to explain Available and unavailable energy, Different types of Thermodynamicrelations,Quantifythesecondlawof thermodynamics for a cycle by establishing the inequality of Clausius. Apply the inequality of Clausius and establish the property entropy of a system.Deriveandapplyprincipleofincreaseofentropytoevaluatethe feasibilityofathermodynamic process
CO4	Illustrate the T-v, P-T diagrams and P-v-T surfaces of pure substances, AnalyzetheprocessesonT-vdiagramstosolveadvancedengineering problems.ExplainPsychometricterms,definitionsanddifferentcharts.
CO5	To calculate efficiencies of simple power and refrigeration cycles. To know and be able to explain the difference between a Carnot and a Rankinecycle.Todefinethemeaningofefficienciesinturbines, compressors,andpumps,andusethemtosolveproblems.

BooksandReferences:

1. Basicand Applied ThermodynamicsbyPK Nag,MCGRAWHILL INDIA.
2. ThermodynamicsforEngineersby Kroos& Potter,CengageLearning.
3. ThermodynamicsbyShavitandGutfinger,CRC Press.
4. Thermodynamics-An EngineeringApproach by Cengel,MCGRAWHILL INDIA.
5. BasicEngineering Thermodynamics, Joel, Pearson.
6. FundamentalsofEngineeringThermodynamicsbyRathakrishnan,PHI.
7. EngineeringThermodynamicsbyDhar,Elsevier.
8. EngineeringThermodynamicsbyOnkar Singh,NewAgeInternational.
9. Engineering Thermodynamics by CP Arora.
10. EngineeringThermodynamicsbyRogers,Pearson.
11. FundamentalsofEngineeringThermodynamicsbyMoran,Shapiro,Boettner,&Bailey,John Wiley.
12. EngineeringThermodynamicsbyMishra,CengageLearning.
13. RefrigerationandAirConditioning byCPArora,MCGRAWHILLINDIA.

ENGINEERINGMECHANICS

(BTME304)

SubjectCode: BTME304	ENGINEERINGMECHANICS	**LTP:310**	**Credits:4**

Courseobjectives:
To develop capacity to predict the effect of force and motion in the course of carrying out the designfunctions of engineering.

UNIT-I:
Two-dimensionalforcesystems:Basic concepts,Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrentandnon-concurrentforcesystems,distribution of force systems,free body diagrams, equilibrium and equations of equilibrium. Friction:Frictionforce–Lawsofslidingfriction–equilibriumanalysisof simplesystemswith sliding friction – wedge friction.

UNIT-II:
Beam:Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.
Trusses:Introduction,simpletrussandsolutionofsimpletruss,methodsofF-jointandmethodsofsections.

UNIT-III:
Centroidandmomentofinertia:Centroidofplane,curve,area,volumeandcompositebodies, momentofinertiaofplanearea,parallelaxistheorem,perpendicularaxistheorem,principlemomentofinertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

UNIT-IV:
Kinematicsof rigidbody:Introduction, planemotion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity.
Kineticsofrigidbody:Introduction,force,massandacceleration,workandenergy,impulseand momentum, D'Alembert's principle and dynamic equilibrium.

UNIT-V:
Simplestressandstrain:Introduction,normalandshearstresses,stress-straindiagramsforductileand brittlematerial,elasticconstants,one-dimensionalloadingofmembersofvaryingcrosssections,strain energy.
Purebendingofbeams:Introduction,simplebendingtheory,stressinbeamsofdifferentcross sections.
Torsion:Introduction,torsionofshaftsofcircularcrosssections,torqueandtwist,shearstressdueto torque.

CourseOutcomes(COs)	**Description**
CO1	Determine the force systems, free body diagrams, equilibrium and equations of equilibrium of a particle in space using principle of laws of mechanics.
CO2	Calculatetheshearforce,bendingmomentdiagram,simpletrussand solutionofsimpletruss.
CO3	Calculatetheprincipalmomentofinertiaofplaneareas.
CO4	Solvetheproblemsusingequationofmotionsandanalyzeimpactof elastic bodies on collision.
CO5	Solve the problems of simple stressand strain, simplebendingtheory, and stressinbeamsofdifferentcross sections.

BooksandReferences:
1. Beer,F.PandJohnstonJr.E.R.,"VectorMechanicsforEngineers(InSIUnits):Staticsand Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).

2. VelaMurali,"Engineering Mechanics", OxfordUniversityPress(2010).

3. ATextbookofEngineering Mechanics,R.K. Bansal, LaxmiPublications.

4. EngineeringMechanics,R.S.Khurmi,S.ChandPublishing.

5. MeriamJ.L.andKraigeL.G.,"EngineeringMechanics-Statics-Volume1,Dynamics-Volume2", Third

Edition, JohnWiley&Sons(1993).

6. Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3 rdEdition, Vikas Publishing House Pvt. Ltd., (2005).

7. Bhavikatti,S.SandRajashekarappa,K.G.,“EngineeringMechanics”,NewAgeInternational(P)Limited Publishers, (1998).

8. EngineeringmechanicsbyIrvingH.Shames,Prentice-Hall.

EngineeringMechanicsLab

(BTME306P)

SubjectCode: BTME307P	EngineeringMechanicsLab	LTP:002	Credits:1

COURSEOBJECTIVES

TodemonstratestudentsthebasicprinciplesofEngineeringMechanics,namely,EngineeringStaticsand Engineering Dynamics. The emphasis will be on psychomotor skills.

ListofExperiments:

1. ToverifytheParallelogramlawofforces.
2. TofindtheforcesinthemembersofJib Crane.
3. ToverifythelawofmomentsusingBellcranklever apparatus.
4. Todeterminetheco-efficientoffrictionbetweenwoodandvarioussurface(likeLeather,Wood, Aluminum) on a Horizontal plane.
5. Todeterminetheco-efficientoffrictionbetweenwoodandvarioussurface(likeLeather,Wood, Aluminum) on an inclined plane.
6. TofindCGandMomentofInertiaofanirregularbodyusingComputation method.
7. Tofindtheaxialforceinthemembersofgiven Truss.
8. TodeterminetheMechanicalAdvantage,VelocityratioandMechanicalefficiencyofaScrewjack.
9. TodeterminetheMechanicaladvantage,VelocityratioandMechanicalefficiencyoftheWheelandAxle.
10. TodeterminetheMechanicaladvantage,VelocityratioandMechanicalefficiencyoftheWormandWorm Wheel.

COURSEOUTCOMES

CO1Tobeabletolearntheconceptoffrictionthroughinclinedplain experiment.

CO2 Tobeabletounderstandapplicationoffrictionin bearing.

CO3Tobeabletounderstandpracticalapplicationofmechanical advantages.
CO4Tobeabletounderstandfundamentalprincipalunderlyingdifferenttypesof gearing.
CO5Tobeabletounderstandtheconceptoffluctuationofenergyanditspracticaluseduring mechanical energy storage process.

MATERIALSENGINEERING(BTME305)

SubjectCode: BTME305	MATERIALSENGINEERING	LTP:310	Credits:4

Courseobjective:

- Understandingofthecorrelationbetweentheinternalstructure ofmaterials, theirmechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- Toprovideadetailedinterpretation ofequilibriumphase diagrams.
- Learningaboutdifferentphasesandheattreatmentmethodstotailorthepropertiesof Fe-Calloys.

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UNIT-I

CrystalStructure:Unitcells,Metalliccrystalstructures,Ceramics.Imperfectioninsolids:Point,line, interfacial and volume defects; dislocation strengthening mechanisms and slipsystems, critically resolved shear stress. Mechanical Property measurement: Tensile, compression and torsion tests; Young'smodulus, relations between true and engineering stress-strain curves, generalized Hooke'slaw, yielding and yield strength, ductility, resilience,toughnessandelastic recovery;Hardness:Rockwell, BrinellandVickers and their relationto strength.

UNIT-II

Staticfailuretheories:Ductileandbrittlefailuremechanisms,Tresca,Von-mises,Maximumnormal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics:Introduction to Stress- intensity factor approach and Griffith criterion. Fatigue failure: Highcycle fatigue, Stress-life approach, SN curve, enduranceand fatigue limits, effects of meanstress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).

UNIT-III

Alloys,substitutionalandinterstitialsolidsolutions-Phasediagrams:Interpretationofbinaryphasediagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron- carbide phase diagram and microstructural aspects ofledeburite, austenite, ferrite and cementite, cast iron.

UNIT-IV

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermaltransformationdiagramsforFe-Calloysandmicrostructuredevelopment.Continuouscooling curves and interpretation of final microstructures and properties- austempering,martempering, case hardening,carburizing, nitriding, cyaniding, carbo-nitriding, flame andinduction hardening, vacuum and plasma hardening.

UNIT-V

Alloyingofsteel,propertiesofstainlesssteelandtoolsteels,maragingsteels-castirons;grey,white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze andcupro-nickel; Aluminium andAl-Cu – Mg alloys- Nickel based superalloys and Titaniumalloys.

CourseOutcomes(COs)	Description
CO1	Explainthecrystalstructure,mechanicalpropertiesandpropertiesof various ferrous and non-ferrous alloys.
CO2	ExplainDuctileandbrittlefailuremechanismsandvariousmechanical testing methods of materials
CO3	Toexplainthephasediagramformulti-componentsystemsandexplain the microstructures development.
CO4	Describevarioustypesofheattreatmentprocessandsketchisothermal transformation.
CO5	DiscusstheproperiesofAlloying of steel, properties of stainless steel, andtool steels.

BooksandReferences:

1. W.D. Callister,2006, "Materials ScienceandEngineering-AnIntroduction", 6thEdition, WileyIndia.
2. KennethG.BudinskiandMichaelK. Budinski,"EngineeringMaterials", PrenticeHallof India Private Limited, 4th Indian Reprint, 2002.
3. V.Raghavan,"MaterialScienceandEngineering',PrenticeHallofIndiaPrivateLimited,

1999.
4. Mechanicsof materialsby JamesM.Gere.
5. Introduction to engineering materialsbyB.K.Agarwal.
6. PhysicalmetallurgyandadvancedmaterialsbyR.E. Smallman.
7. EngineeringmechanicsofcompositematerialsbyIsaac M.Daniel.
8. U.C.Jindal, “EngineeringMaterialsandMetallurgy”,Pearson, 2011.

MATERIALTESTINGLAB(BTME307P)

SubjectCode: BTME307P	MATERIALTESTINGLAB	LTP:002	Credits:1

Courseobjectives

Tounderstandtheprinciplesandperformancecharacteristicsdifferentmaterials. To know about material properties

Totestseveralpropertiesofmateriallike ductility, surface roughness, malleability, hardenability etc.

ListofExperiments:(Atleast8ofthefollowing)

1. Strength test of a given mildsteelspecimen on UTM with full details andstress versus strain plot onthe machine.
2. Othertestssuch asshear,bendtests onUTM.
3. Impacttestonimpact testingmachinelike Charpy,Izodor both.
4. Hardnesstest ofgivenspecimenusingRockwellandVickers/Brinelltestingmachines.
5. Springindex test onspringtesting machine.
6. Fatigueteston fatiguetesting machine.
7. Creeptestoncreeptestingmachine.
8. Experiment on deflection of beam, comparison of actual measurement of deflection with dial gaugetothe calculated one, and or evaluation of young's modulus of beam.
9. Torsiontestof a rod usingtorsiontestingmachine.
10. StudyofNDT(non-destructivetesting)methodslikemagneticflawdetector,ultrasonicflawdetector,eddy current testing machine, dye penetrant tests.

CourseOutcomes:

CO1

Tobeabletounderstanddeformationofaspecimenby torsion.

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CO2

Tounderstandtheconceptofimpactandtestedeffectsona notched M.S. Specimen by Izod Impact Test.

CO3

Tobeabletoustensiometerfortensiletestofsheetmetal.

CO4

Tobeabletomeasurestiffnessofvarious compositions of helical spring system.

CO5

To understand property of hardness ofdifferentmaterialsandbeabletouseRockwell hardness testing machine for hardness test.

COMPUTERAIDEDMACHINEDRAWING-ILAB(BTME308P)

SubjectCode: BTME308P	COMPUTER AIDED MACHINE DRAWING-ILAB	LTP:002	Credits:1

Courseobjectives:
Toprovideanoverviewofhowcomputers canbeutilizedinmechanicalcomponentdesign.

UNIT-I
Introduction(1drawingsheets)
Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, lines and rules of dimensioning.
OrthographicProjections(3drawing sheets)
Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.

UNIT-II
Fasteners(2drawingsheets)
Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.

UNIT-III
Rivetedjoints(1drawingsheet)
Introduction,rivetsandriveting,typesof rivets, typesofrivetedjoints,drawingofboilerjointsetc. Free handsketching(1 drawing sheet)
Introduction,Needforfreehandsketching,Freehandsketchingoffoundationbolts,studs,pulleys, couplings etc.

UNIT-IV
Assemblydrawing(2drawingsheets)
Introduction to assemblydrawing, drawing assembly drawing of simplemachine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.

UNIT-V
Computeraideddrafting(1 drawing)
Introduction to computer aided drafting; advantages and applications of CAD, concepts of computeraided 2D drafting using any drafting software like AutoCAD, Solid Edge,Draft Sightetc., basic drawand modify commands, making 2D drawings of simple machine parts.

CourseOutcomes:
(CO)1Studentswillbeabletounderstandknowledgeofengineeringdrawingethicsinsimplemachine components.
CO2Studentswillbeabletounderstandandapplyorthographicprojectionforsimplemachineelements. CO3 Students will be able to understand various types of fasteners used for permanent and temporary joints like Screw, Bolt and rivet etc.

CO4Students will be able to understand knowledge of free hand sketching for machine components CO5Studentswillbeabletounderstandassemblydrawingofcouplingsandbrackets6Studentswillbe able to understand and apply CAD software for drafting machine

BooksandReferences:

1. FundamentalsofMachineDrawingbySadhuSingh&Shah, PHI.
2. EngineeringDrawingbyBhat,&Panchal,CharotarPublishingHouse.
3. MachineDrawingwithAutoCADbyPohitandGhosh, Pearson.
4. MachineDrawing-KLNarayana,PKannaiah,KVReddy,New Age.
5. MachineDrawing,N. Siddeshswar,P Kannaiah,VVSShastry,TataMcGraw Hill.
6. EngineeringDrawing,Pathak,
Wiley.
7. TextbookofMachineDrawing,KCJohn, PHI.
8. AutoCAD 2014forEngineers&Designers,Bhatt, WILEY

MiniProjectorInternshipAssessment(BTME309P)

SubjectCode: BTME309P	MiniProjectorInternshipAssessment	LTP:002	Credits:2

CourseObjectives:

1. ToprovidestudentsforknowledgeofElectronicsComponentsandsolderingtechniquesanditspackage information for electronics circuit design.

2. Knowledgefortheassemblingofelectronicscircuitwithcomponentson PCB(PrintedCircuitBoard)of circuit design.

3. DesignanddevelopmentofSmallelectronicprojectbasedonhardwareandsoftwareforelectronics systems.

CourseOutcome:Attheendofthiscourse,studentswillbeableto:

1. Studentswillbeabletopracticeacquiredknowledgewithinthechosenareaoftechnologyforproject development.

2. Identify,discussandjustifythetechnicalaspectsofthechosenprojectwithacomprehensiveand systematic approach.

3. Reproduce,improveandrefinetechnicalaspectsforengineeringprojects.

4. Workasanindividualorinateamindevelopmentoftechnicalprojects.

5. Communicateandreporteffectivelyprojectrelatedactivitiesandfindings.

Semester-IV

MeasurementandMetrology

[BTME401]

SubjectCode: BTME401	**MeasurementandMetrology**	**LTP:300**	**Credits:3**

COURSEOBJECTIVE

To enable students to understand the construction and operation of instruments for measurement of pressure; level; flow and temperature; describe a suitable calibration procedure for a particular measurementinstrument; identifyandquantifyerrorsfromcalibrationgraphsanddescribecorrectionproceduresforselectedinstruments; selectasuitablemeasurementinstrumentforagivenprocessmeasurement;solvenumericalproblemsinvolving equations pertaining to pressure; level; temperature and flow measurements

Unit-I

Mechanical Measurements: Introductiontomeasurementandmeasuringinstruments. General concept– Generalized measurement system and its elements-Unit sand standards- measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response- repeatability-systematic, Source of error, statistical analysis of error and random errors- correction, calibration. Dimensional and geometric tolerance

SensorsandTransducers:Typesof sensors,typesof transducersandtheir characteristics.

Unit-II

TimeRelatedMeasurements: Stroboscope,frequency measurementbydirectcomparison. Measurement of displacement

MeasurementofPressure: Gravitational,directingacting,elasticandindirecttypepressuretransducers. Measurement of very low pressures (high vacuum).
StrainMeasurement:Typesofstraingaugesandtheirworking,straingaugecircuits,temperature compensation. Strain rosettes, calibration.

Unit-III

Flow Measurement: Hot WireAnemometry,LaserDopplerVelocimetry,Rotameter

TemperatureMeasurement:Thermometers,bimetallicthermocouples,thermistorsandpyrometers.

MeasurementsofForce,Torque: Differenttypesofloadcells,elastictransducers,pneumatic& hydraulic systems. Seismic instruments

MeasurementsofAcceleration,andVibration:Accelerometersvibrationpickupsand decibel meters,vibrometers.

Unit-IV

Coordinatemeasuring machine(CMM): Need,constructionalfeatures and types,

Metrology and Inspection: Standards of linear measurement, line and end standards.Interchange ability and standardization. Linear and angular measurements devices and systems **Comparators:** Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.

Unit-V

Limits,Fits&ToleranceandSurfaceroughness: IntroductiontoLimits,Fits,Tolerancesand IS standards, Limit-gauges, and surface-roughness. Measurement of geometric forms like

straightness,flatness,roundness.Toolmakersmicroscope,profileprojector,autocollimator.**Interferometry**: principleanduseofinterferometry,opticalflat.Measurementofscrew threadsandgears.Surface texture:quantitativeevaluationofsurfaceroughnessandits measurement.

CourseOutcomes(COs)	Description
CO1	• Tounderstandtheconceptsinmeasurementandmetrology.To familiarwithvariousstandardsandcalibrationmethodsusedin industry.
CO2	• Tobefamiliarwithdifferentsensorsandtransducers
CO3	• Tobuildsuitablemeasurement technique
CO4	• Tohavetheconfidencetoapplyautomationsolutionsforgiven industrial applications.
CO5	• Todemonstratetheabilitytodesignandconductexperiments, interpret and analyze data, and report results.

Booksand References:

1. ExperimentalMethods forEngineers byHolman,MCGRAW HILLINDIA
2. MechanicalMeasurementsby Beckwith, Pearson
3. PrinciplesofMeasurementSystems byBentley, Pearson
4. MetrologyofMeasurementsby BewoorandKulkarni, MCGRAW HILL INDIA
5. MeasurementSystems,ApplicationDesignbyDoeblein,MCGRAWHILLINDIA
6. HumeKJ,“EngineeringMetrology”, MacDonaldandCo
7. Jain,RK,“EngineeringMetrology” KhannaPublishers
8. Jain,R.K.,“MechanicalMeasurement”Khanna Publishers
9. GuptaSC,EngineeringMetrology,DhanpatRai Publications

MeasurementandMetrology-Lab

[BTME409P]

SubjectCode: BTME409P	**MeasurementandMetrology-Lab**	**LTP:002**	**Credits:1**

COURSEOBJECTIVE

1. Identify the uncertainties in dimensional metrology and the define the measurement standards; describethe fundamentalsofdimensional andgeometrical tolerances; 2. Measure lengthandangles usingline-graduatedinstruments,i.e.vernier calipers, micrometers, bevel protractor,sinebarandsurfaceplates;3.Usecomparativelength-measuringinstruments,i.e. dial indicator, to measure variations in the distance between two or more surfaces; Measurements on precision instruments; sine bar

Minimum8experimentsoutoffollowing (orsuchexperiment)are tobe performed:

1. Study theworking of simplemeasuring instruments-Vernier calipers,micrometer, tachometer.
2. Measurementofeffectivediameterof ascrewthreadusing3 wiremethod.
3. Measurementofangle usingsine bar&slipgauges. Studyof limitgauges.
4. Study&angularmeasurementusinglevel protector.
5. Adjustmentofspark pluggapusingfeeler gauges.
6. Studyofdialindicator&itsconstructional details.
7. Useofdialindicatortocheckashape runuse.
8. Useofdialindicator andVBlocktocheckthe circularityandplotthepolarGraph.
9. Studyandunderstandingoflimits,fits&tolerances.
10. Experimentonmeasurementof pressure.
11. Studyoftemperature measuring equipments.
12. MeasurementusingStraingauge.
13. Measurementof speedusingstroboscope.
14. Experimentonmeasurementofflow.
15. Measurementof vibration/power.
16. Experimentondynamometers.
17. TostudythedisplacementusingLVDT.

CourseOutcomes:

UponcompletionofthiscourseStudentsareableto

.1.Demonstrateandusedifferentlengthmeasuringinstrumentslikevernier calipersandmicrometers.

1. Explaindifferentanglemeasuringinstrumentlikeuniversalbevelprotractor,sinebar
2. .3.Formulatesomeunknownquantityorparameterofengineeringinterest.
3. .4.Evaluatethesurfacequalityofagivenspecimenwhichisimportantinallkindofmanufacturing.

Universal Human ValuesandProfessional Ethics

[BTME402]

SubjectCode: BTME402	**Universal Human Valuesand Professional Ethics**	**LTP:300**	**Credits:3**

Courseobjectives:

1. Tohelpstudentsdistinguishbetweenvaluesandskills,andunderstandthe need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession.
3. Tohelpstudentsunderstandthemeaningofhappinessandprosperityforahuman being.
4. Tofacilitatethestudentstounderstandharmonyatallthelevelsofhumanliving, andliveaccordingly.
5. Tofacilitatethestudentsinapplyingtheunderstandingofharmonyinexistenceintheirprofession and lead an ethical life

CourseOutcome:

Oncompletionofthiscourse,the students willbeableto

1. Understandthesignificanceofvalueinputsinaclassroom,distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.
2. DistinguishbetweentheSelfandtheBody,understandthemeaningof Harmony in the Self the Co- existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and othernaturallyacceptable feelingsinhuman-humanrelationshipsand explore their role in ensuring a harmonious society.
4. Understandtheharmonyinnatureandexistence,andworkouttheir mutually fulfilling participation in the nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

UNIT-1

CourseIntroduction-Need,BasicGuidelines,ContentandProcessforValueEducationUnderstanding the need, basic guidelines, contentand process for ValueEducation, Self-Exploration–whatisit?-itscontent andprocess;'NaturalAcceptance'and Experiential Validation- as the mechanism for self exploration, Continuous HappinessandProsperity-AlookatbasicHumanAspirations,Right understanding, RelationshipandPhysicalFacilities-thebasicrequirementsfor fulfillment of aspirations of every human being with their correct priority, UnderstandingHappinessandProsperitycorrectly-Acriticalappraisalof the current scenario, Method to fulfillthe above human aspirations: understanding and living in harmony at various levels.

UNIT-2

UnderstandingHarmonyintheHumanBeing-Harmonyin Myself Understanding human being as a co-existenceofthesentient'I'andthematerial'Body',UnderstandingtheneedsofSelf('I')and'Body'- Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding thecharacteristicsandactivitiesof'I'andharmonyin'I',UnderstandingtheharmonyofIwiththe Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-3

UnderstandingHarmonyintheFamilyandSociety-HarmonyinHuman-HumanRelationship Understanding harmony in the Family- the basic unit of human interaction, Understandingvaluesinhuman-humanrelationship;meaningofNyayaand programforitsfulfillmenttoensureUbhay-tripti;Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas;Differencebetweenintentionandcompetence,Understandingthe meaningofSamman, Differencebetweenrespectanddifferentiation;theothersalientvaluesinrelationship,Understandingthe

harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- UndividedSociety (AkhandSamaj),UniversalOrder(SarvabhaumVyawastha)- from family to world family!.

UNIT-4

UnderstandingHarmonyintheNatureandExistence-Whole existenceso-existence Understandingthe harmonyintheNature,Interconnectednessandmutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva)of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-5

Implicationsof theaboveHolisticUnderstanding of Harmony on Professional Ethics Naturalacceptanceof human values, Definitiveness of EthicalHuman Conduct, BasisforHumanisticEducation,Humanistic ConstitutionandHumanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b)Abilityto identifythescopeand characteristicsofpeople-friendlyandeco-friendly production systems, technologies and managementmodels, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

CourseOutcome:

CourseCode:BTME402,CourseNameBTECH(UniversalHumanValuesandProfessionalEthics)

CourseOutcomes(COs)	Description
CO1	Understand the significance of valueinputsinaclassroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore themeaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.
CO2	DistinguishbetweentheSelfandtheBody,understandthe meaningofHarmonyinthe Selfthe Co-existenceofSelfandBody
CO3	Understand the value of harmonious relationship based on trust,respect and other naturally acceptable feelings in human-human relationshipsand explore their role in ensuring a harmonious society.
CO4	Understandtheharmonyinnatureandexistence,andworkout their mutually fulfilling participation in the nature.
CO5	Distinguishbetweenethicalandunethicalpractices,andstart working out the strategy to actualize a harmonious environment wherever they work.

TextBooks:

1. RR Gaur,RSangal, GPBagaria,2009,AFoundationCourseinHumanValues andProfessionalEthics.

References:

1. IvanIllich,1974,Energy&Equity,TheTrinityPress,Worcester,andHarperCollins,USA
2. E.F.Schumacher,1973,SmallisBeautiful:astudyofeconomicsasifpeoplemattered,Blond&Briggs, Britain.
3. SussanGeorge,1976,HowtheOtherHalfDies,PenguinPress.Reprinted1986,1991
4. DonellaH.Meadows,DennisL.Meadows,JorgenRanders,WilliamW.BehrensIII,1972,LimitstoGrowth–ClubofRome'sreport,Universe Books.
5. ANagraj,1998,Jeevan VidyaEkParichay,DivyaPathSansthan,Amarkantak.
6. PLDhar,RRGaur,1990,ScienceandHumanism,CommonwealthPublishers.
7. AN Tripathy,2003,HumanValues,New AgeInternational Publishers.
8. SubhasPalekar, 2000,HowtopracticeNaturalFarming,Pracheen(Vaidik)KrishiTantraShodh,Amravati.

9. EGSeebauer&RobertL.Berry,2000,FundamentalsofEthicsfor Scientists & Engineers , Oxford University Press.
10. MGovindrajran,SNatrajan&V.S.SenthilKumar,EngineeringEthics(includingHuman Values), EasternEconomyEdition,PrenticeHallof India Ltd.
11. BPBanerjee, 2005,Foundationsof Ethicsand Management,ExcelBooks.
12. BLBajpai,2004,IndianEthosandModernManagement,NewRoyal Book Co., Lucknow. Reprinted 2008.

ModeofEvaluation:
Assignment/Seminar/ContinuousAssessment Test/SemesterEnd Exam

1. RR Gaur,RSangal,GPBagaria, 2009,A FoundationCoursein HumanValuesandProfessionalEthics.

APPLIEDTHERMODYNAMICS
(BTME403)

SubjectCode: BTME403	APPLIEDTHERMODYNAMICS	LTP:300	Credits:3

CourseObjectives:

- Tolearn aboutofIlaw forreacting systemsand heatingvalueoffuels.
- Tolearnaboutgasand vaporcyclesandtheirfirstlawandsecondlaw efficiencies.
- Tounderstandaboutthepropertiesofdryandwet airandtheprinciples ofpsychrometry.
- Tolearnaboutgasdynamicsof airflowand steam through nozzles.
- Tolearnthe aboutreciprocatingcompressorswithandwithoutintercooling.
- To analyze theperformanceofsteamturbines.

UNITI
Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First lawanalysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flametemperature- Chemical equilibrium and equilibrium composition calculations using freeenergy. Introduction and Otto, Diesel and Dual cycles.

UNITII
VapourPowercycles:
Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect oftemperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

UNITIII
Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boilertrialandheatbalance.Condenser:Classificationofcondenser,airleakage,condenser performance parameters.

UNIT IV
SteamandGas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity,areaandspecificvolume,chokedflow,throatarea,Nozzleefficiency,Offdesignoperation ofnozzle, Shock wavesstationary normalshockwaves,Effectoffrictiononnozzle, Super saturated flow. SteamTurbines:Classificationofsteamturbine,ImpulseandReactionturbines,Staging,Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNITV
GasTurbine:Gasturbineclassification,Braytoncycle,Principlesofgasturbine,Gasturbinecycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles. JetPropulsion: Introductiontotheprinciplesofjet propulsion, Turbojet and turboprop engines andtheir processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Reciprocatingcompressors, stagingof reciprocatingcompressors, optimal stage pressureratio, effect of intercooling, minimum work for multistage reciprocating compressors.

CourseOutcomes(COs)	Description
CO1	To understandthe applicationsof engineeringthermodynamicsin real life situationsTo perform gas power cycle analysis
CO2	They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
CO3	Theywillbeabletounderstandphenomenaoccurringinhighspeed

	compressible flows.
CO4	Toperformvaporpowercycle analysis
CO5	Toanalyzethermodynamicsystemwithcompressiblefluid

BooksandReferences:

1. BasicandApplied Thermodynamicsby P.K.Nag,mcgrawhillindia.
2. AppliedthermodynamicsbyOnkar Singh,NewAgeInternational.
3. AppliedThermodynamicsforEngineeringTechnologistsbyEastop,Pearson Education.
4. AppliedThermodynamicsbyVenkannaAnd Swati,PHI.
5. Sonntag,R.E, Borgnakke,C.andVan Wylen, G. J.,2003,6th Edition, Fundamentalsof Thermodynamics, John Wiley and Sons.
6. Jones,J. B.and Duggan,R.E.,1996,EngineeringThermodynamics,Prentice-HallofIndia
7. Moran,M. J.andShapiro,H.N., 1999,FundamentalsofEngineeringThermodynamics, JohnWileyand Sons.
8. Theoryof Stream Turbineby WJKearton.

FLUIDMECHANICS AND FLUIDMACHINES
(BTME404)

3-1-0

SubjectCode: BTME404	**FLUIDMECHANICS AND FLUID MACHINES**	**LTP:310**	**Credits:4**

CourseObjectives:

- Tolearnabouttheapplicationofmass andmomentumconservationlawsfor fluidflows.
- Tounderstandtheimportanceofdimensionalanalysis.
- Toobtainthevelocityandpressure variationsinvarioustypesofsimpleflows.
- Toanalyzethe flowinwaterpumpsandturbines.

UNIT-I
Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids,mass density, specific volume, specific gravity, viscosity, compressibility and surfacetension, Incompressible flow, Bernoulli'sequationanditsapplications- Pitottube,orificemeter,venturimeterandbendmeter, notches and weirs, momentum equation and its application to pipe bends.

UNIT-II
Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar andturbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two- and three- dimensionalflows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential. Buckingham's Pi theorem, important dimensionless numbers and their significance.

UNIT-III
Equation of motion for laminar flow through pipes, turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems andpipe networks. Boundary layerthickness,boundary layeroveraflatplate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift, drag on a sphere, a two-dimensional cylinder, and an aerofoil, Magnus effect.

UNIT-IV
Introduction to hydrodynamic thrust of jet on a fixed and moving surface, Classification of turbines, Impulseturbines,Constructionaldetails, Velocity triangles,Powerandefficiency calculations, Governing of Pelton wheel. FrancisandKaplanturbines,Constructionaldetails,Velocitytriangles, Powerandefficiency Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

UNIT-V
Classificationsofcentrifugalpumps,Vectordiagram,Workdonebyimpellor,Efficienciesof centrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics. Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics.

CourseOutcomes(COs)	Description
CO1	Obtainingasolidunderstandingofthefundamentalsof FluidMechanics
CO2	Theabilitytoformulatebasicequationsfor FluidEngineeringproblems
CO3	Theability tousetablesandfigurestodeterminethefrictionenergyloss for various pipes/ducts geometries and Fluid engineering applications
CO4	Theywillbe ableto evaluatethe performanceofpumpsandturbines.
CO5	Theabilitytoperformdimensionalanalysisandidentifyimportant parameters

BooksandReferences:

1. IntroductiontofluidmechanicsandFluidmachinesby S.KSom,GautamBiswas, SChakraborty.
2. Fluidmechanicsandmachinesby R.KBansal.
3. F.M.White,FluidMechanics,6thEd.,TataMcGraw-Hill,2008.
4. FluidMechanicsandIts ApplicationsbyV.K.Guptaet.al.
5. Fluid MechanicsbyYunusCengel.
6. Batchelor,G.K.(1999). Introductiontofluid dynamics.NewDelhi, India:Cambridge University Press.
7. Acheson,D.J.(1990).Elementary fluid dynamics. New York,USA: Oxford UniversityPress.
8. R.W. Fox, A.T. McDonaldand P.J.Pritchard, Introduction to Fluid Mechanics, 6thEd., JohnWiley, 2004.

FLUIDMECHANICS LAB
(BTME408P)

SubjectCode: BTME408P	FLUIDMECHANICSLAB	LTP:002	Credits:1

Courseobjectives:

2

- Tounderstandtheprinciplesandperformancecharacteristicsofflowandthermal devices.
- Toknowaboutthemeasurementofthe fluid properties.

ListofExperiments:(Atleast8ofthefollowing)

1. Todeterminethecoefficientofimpactforvanes.
2. Todetermine coefficientof dischargeofanorificemeter.
3. Todetermine thecoefficientof discharge of Notch(VandRectangular types).
4. Todetermine thefrictionfactorforthe pipes.
5. Todeterminethecoefficientofdischarge ofventuri meter.
6. Todetermine thecoefficientof discharge, contraction&velocityofanorifice.
7. Toverify theBernoulli'sTheorem.
8. To find criticalReynoldsnumber fora pipeflow.
9. Todetermine themeta-centricheightofafloating body.
10. Todeterminetheminorlossesduetosuddenenlargement,suddencontractionand bends.
11. Toshowthevelocityandpressurevariationwithradiusinaforcedvertexflow.

CourseOutcomes:

CO1
Tobeabletodeterminecoefficientofdischargeat60to90degreeV-Notch.

CO2TobeabletodeterminecoefficientoffrictionforGIpipesandtocompareitfrom Moody's Chart

CO 3 To be able to measure various properties of fluids and
CO4Characterizetheperformanceoffluid/thermalmachinery.

MANUFACTURINGPROCESSES
(BTME405)

SubjectCode: BTME405	MANUFACTURINGPROCESSES	LTP:310	Credits:4

CourseObjectives

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

UNIT-1
ConventionalManufacturingprocesses:
Casting and moulding: Metal casting processes and equipment, Heat transfer andsolidification,shrinkage, riser design, casting defects and residual stresses.Introduction to bulk and sheet metal forming, plastic deformation and yield criteria;fundamentals of hot and cold working processes; load estimation for bulk forming (forging,rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principlesof powder metallurgy.

UNIT-II

Metalcutting:Singleandmulti-pointcutting;Orthogonalcutting,variousforcecomponents:Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes,Introduction to CNC machining.Additive manufacturing: Rapid prototyping and rapid toolingJoining/fastening processes: Physicsofwelding,brazingandsoldering;design considerationsinwelding,Solidandliquidstate joining processes;Adhesive bonding.

UNIT-III
Grinding & Super finishing:Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheelspecification.Grinding wheelwear-attritionswear,fracturewear.DressingandTruing. MaxchipthicknessandGuest criteria. Surface and cylindrical grinding. Centreless grinding.
Super finishing: Honing, lapping and
polishing.

UNIT-IV
MetalJoining(Welding):Survey of welding andallied processes. Gas weldingandcutting, process and equipment. Arc welding:Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Weld decay in HAZ.

UNIT-V
UnconventionalMachiningProcesses:AbrasiveJetMachining,WaterJetMachining,Abrasive Water Jet Machining, UltrasonicMachining, principlesandprocessparameters.ElectricalDischargeMachining,principleandprocesses parameters, MRR, surface finish,tool wear,dielectric, power and control circuits, wire EDM; Electro- chemical machining(ECM), etchant &maskant, process parameters, MRR and surface finish.Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron BeamMachining.

CourseOutcomes(COs)	Description
CO1	Tounderstandvariousmanufacturingprocesses&itsclassifications
CO2	TounderstandvariousCastingprocesses
CO3	Tounderstandvariousweldingprocesses
CO4	Tounderstandvariousmetalremovalprocess

CO5	Toappreciatethecapabilities,advantagesandthelimitationsofthe processes

BooksandReferences:

1. Kalpakjianand Schmid,Manufacturingprocessesfor engineeringmaterials(5th Edition)-PearsonIndia,2014.
2. MikellP. Groover,FundamentalsofModernManufacturing: Materials,Processes,and Systems.
3. ManufacturingTechnologybyP.N. Rao.,MCGRAWHILL INDIA.
4. Materialsand ManufacturingbyPaulDegarmo.
5. ManufacturingProcessesbyKaushish,PHI.
6. PrinciplesofFoundry Technology,Jain,MCGRAWHILLINDIA
7. Production Technology byRKJain.
8. Degarmo, Black&Kohser,MaterialsandProcesses inManufacturing.

APPLIEDTHERMODYNAMICS LAB

(BTME406P)

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SubjectCode: BTME406P	APPLIEDTHERMODYNAMICS LAB	LTP:002	Credits:2

Courseobjectives

Tounderstandtheprinciples andperformanceofvarious boilers andengines

ListofExperiments:(Atleast8ofthefollowing)

1. StudyofFireTubeboiler.
2. Studyof Water Tubeboiler.
3. Study andworkingofTwostrokepetrolEngine.
4. StudyandworkingofFourstrokepetrolEngine.
5. DeterminationofIndicatedH.P.ofI.C.Engineby MorseTest.
6. Preparethe heatbalancesheetforDiesel Engine testrig.
7. Preparethe heatbalancesheetforPetrolEnginetestrig.
8. Study andworkingoftwo stroke DieselEngine.
9. StudyandworkingoffourstrokeDiesel Engine.
10. Study ofVelocity compounded steamturbine.
11. Studyof Pressure compoundedsteamturbine.
12. StudyofImpulse &Reactionturbine.
13. StudyofsteamEnginemodel.
14. Studyof GasTurbineModel.

CourseOutcomes:

Attheendofthecourse, studentswillbeableto:

1. ConducttestonBombcalorimeter,nozzle,steamturbine,condenser,compressor etc. to study their performance.
2. Drawperformancecurvesofthesemachines.
3. Analyzetheresultsobtainedfromthe tests.
4. Drawconclusionsbasedontheresultsofthe experiments
5. BasedonyourvisittoIndustry, sketchitslayoutandwrite specifications

MANUFACTURING PROCESS LAB
(BTME 407P)

SubjectCode: BTME407P	**MANUFACTURING PROCESS LAB**	**LTP:002**	**Credits:2**

Objectives:
To motivate and challenge students to understand and develop an appreciation of the processes in correlation withmaterialpropertieswhichchangetheshape,sizeandformoftherawmaterialsintothedesirable product by conventional or unconventional manufacturing methods.

ListofExperiments:(Atleast8ofthefollowingalong-withstudyofthemachines/processes)

1. Shear-angledetermination(usingformula)withtubecutting (fororthogonal) onlathemachine.
2. Bolt(thread) makingonLathemachine.
3. Tool grinding(toprovidetoolangles)ontool-grinder machine.
4. Gearcuttingonmilling machine.
5. Machininga blockon shapermachine.
6. Finishingofasurfaceonsurface-grinding machine.
7. Drillingholesondrillingmachineandstudy oftwist-drill.
8. Studyofdifferenttypesoftoolsanditsangles&materials.
9. Experimenton toolwearandtoollife.
10. Experimenton jigs/Fixtures anditsuses.
11. Gas weldingexperiment.
12. Arc weldingexperiment.
13. Resistancewelding experiment.
14. Soldering&Brazing experiment.
15. Studyandunderstandingof limits,fits&tolerances.
16. Studyof temperaturemeasuring equipment's.
17. Measurement using Straingauge.
18. Experimentondynamometers.
19. Tostudythedisplacementusing LVDT.

CourseOutcomes:
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto
CO1 Demonstrate various processes used for casting, joining, sheet metal and plastic processing.
CO2Fabricateweldmentsusingarc,gas,resistanceandTIGwelding.
CO3Analyzethepropertiesofmouldingsands,preparepatternandmouldcavityusing sand casting. CO4 Experiment formability studies on sheet metal
CO5Analysedifferentmouldingmethodsofmanufacturingplasticscomponents.

Semester-V

SubjectCode: BTME501	HeatandMassTransfer	LTP:310	Credits:4

COURSEOBJECTIVE

This course imparts basic knowledge of heat transfer and the knowledge imparted will enable him to reduce or increase heat transfer in existing equipment as the need may be and be able to go for preliminary design of heat exchanger

UNIT-1

Introduction to Heat Transfer (L-5 Hours) Introduction of thermodynamics and Heat Transfer, Modes of Heat Transfer: Conduction, convection and radiation, Effect of temperature on thermal conductivity of different types of materials, Introduction to combined heat transfer mechanism, General differential heat conduction equation in the rectangular,cylindricalandsphericalcoordinatesystems,Initialandsystemboundaryconditions.

SteadyStateone-dimensionalHeat conduction (L-3 Hours)

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy 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-3 Hours)

Heattransferthroughextendedsurfacesanditsclassification,Finsofuniformcross-sectionalarea,Error in measurement of temperature of thermometer wells.

TransientConduction (L-3 Hours)

Transientheatconduction,Lumpedcapacitancemethod,Timeconstant,Unsteadystateheatconductioninone dimension only, Heisler charts and their applications.

UNIT-3

Forced Convection (L-5 Hours) Basic concepts: Hydrodynamic boundary layer, Thermal boundary layer, Approximateintegralboundarylayeranalysis,Analogybetweenmomentumandheattransferinturbulentflowover a flat surface, Mixed boundary layer, Flow over a flat plate, Flow across a single cylinder and a sphere, Flowinside ducts, Thermal entrance region, Empirical heat transfer relations, Relation between fluid friction and heat transfer, Liquid metal heat transfer.

NaturalConvection (L-5 Hours)

Physical mechanism of natural convection, Buoyant force, Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates, cylinders and sphere, combined free and forced convection, Effect of turbulence.

UNIT-4

Thermal Radiation (L-8 Hours) Basic concepts of radiation, Radiation properties of surfaces, Black body radiationPlanck'slaw,Wein'sdisplacementlaw,Stefan-Boltzmannlaw,Kirchhoff'slaw,Graybody,Shapefactor, Black-body radiation, Radiation exchange between diffuse non-black bodies in an enclosure, Radiation shields, Radiationcombinedwithconductionandconvection;Absorptionandemissioningaseous medium; Solarradiation; Greenhouseeffect,Radiationnetworkanalysis.

UNIT-5

HeatExchanger(L-5Hours) Differenttypesofheatexchangers,Foulingfactors,Overallheattransfercoefficient, Logarithmic mean temperature difference (LMTD) method, Effectiveness-number of transfer unit (NTU) method and Compact Heat Exchangers.

CondensationandBoiling (L-3 Hours)

Introduction of condensation phenomena, Heat transfer relations for laminar film condensation on vertical surfaces and on outside& inside of a horizontal tube, Effect of non-condensable gases, Drop wise condensation, Heat pipes, Boiling modes, pool boiling, Hysteresis in boiling curve, Forced convection boiling.

IntroductiontoMassTransfer (L-2 Hours)

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

Thestudentswillbeableto		**Blooms Taxonomy**
CO-1	**Understandthefundamentalsofheatandmass transfer.**	**K2**
CO-2	**Applytheconceptofsteadyandtransientheatconduction.**	**K3**
CO-3	**Applytheconceptofthermalbehavioroffins.**	**K3**
CO-4	**Applytheconceptofforcedandfreeconvection.**	**K3**
CO-5	**Applytheconceptofradiationforblackandnon-black bodies.**	**K3**
CO-6	**Conductthermalanalysisofheatexchangers.**	**K4**

ReferenceBooks:-

1. FundamentalsofHeatandMassTransfer,byIncroperra&DeWitt,JohnWileyand Sons
2. HeatandMassTransferbyCengel,McGraw-Hill
3. HeatTransferbyJ.P.Holman,McGraw-Hill
4. HeatandMassTransferbyRudramoorthyandMayilsamy,Pearson Education
5. HeatTransferbyGhoshdastidar,OxfordUniversity Press
6. AtextbookonHeatTransfer,bySukhatme,UniversityPress.
7. HeatTransferbyVenkateshan,AneBooksPvtLtd
8. Schaum'soutlineofHeatTransferbyPitts&SissonMcGraw-Hill
9. HeatandMassTransferbyRYadav,CentralPublishing House

StrengthofMaterialSubjectCode:BTME502

SubjectCode:BTME502		Strengthof Material	LTP:310	Credits:4

CourseObjectives:

1) Tostudyaboutidentificationofdifferenttypesofforces,systematicevaluationof effectoftheseforces,behaviorofrigidbodiessubjectedtovarioustypesofforces,at the state of rest or motion of the particles.
2) To understand the fundamental principal, concepts and techniques, both theoretical and experimental, with emphasis on the application of these to the solution of Mechanics based suitable problems in all engineering

UnitI **8Hours**

Compound stress and strains: 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 **8 Hours**

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

DeflectionofBeams: Differentialequationoftheelasticcurve,cantileverandsimplysupportedbeams, Macaulay's method, area moment method, fixed and continuous beams

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

UnitIII **8 Hours**

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 columns in mechanical equipment and machines.

UnitIV **8 Hours**

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.

Thickcylinders: Radial,axialandcircumferentialstressesinthickcylinderssubjectedtointernalorexternal pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

UnitV **8 Hours**

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.

CourseOutcomes:Thestudentwillbeableto		**Blooms Taxonomy**
CO 1	Understandtheconceptofstressandstrainunderdifferentconditionsofloading	K2
CO 2	Determinetheprincipalstressesandstrainsinstructural members	K3
CO 3	Determinethestressesandstrainsinthememberssubjectedtoaxial,bending and torsionalloads	K3
CO 4	Applytheconceptsofstressesandstraininsolvingproblemsrelatedto springs, columnandpressurevessels	K3
CO 5	Calculatetheslope,deflectionandbucklingofloaded members	K3
CO 6	Analyzethestressesdevelopedinstraightandcurvedbeamsofdifferentcross sections	K4

Text Books:

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

ReferenceBooks:

1. MechanicsofMaterialsbyHibbeler,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,MCGRAWHILLINDIA
10. StrengthofMaterialsbyJindal,PearsonEducation
11. StrengthofMaterialsbyBasavajaiahandMahadevappa,UniversityPress.

SubjectCode:BTME503	IndustrialEngineering	LTP:310	Credits:4

COURSEOBJECTIVE

The course provides knowledge of work study; work force management; cost analysis; PPC; MIS and product design. After going through the course; the student will be able to manage factory activities in a proper and efficient manner

Unit-I:

OverviewofIndustrialEngineering:Typesofproductionsystems,conceptofproductivity,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,deterministicinventorymodels,perpetualandperiodicinventorycontrolsystems,ABC analysis,andVEDanalysis.

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-motion study, principles of motion economy; work measurement –time study, 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, degeneracy and unbound solutions. transportation and assignment models; Optimality test: the stepping stone method and MODI method, simulation.

CourseOutcomes:Thestudentswillbeableto		**Blooms Taxonomy**
CO1	Understandtheconceptofproductionsystem,productivity,facilityandprocess planninginvariousindustries	K2
CO2	Applythevariousforecastingandprojectmanagementtechniques	K3
CO3	Applytheconceptof break-evenanalysis,inventorycontrol andresource utilizationusingqueuingtheory	K3
CO4	Applyprinciplesofworkstudyandergonomicsfordesignofworksystems	K3
CO5	Formulatemathematicalmodelsforoptimalsolutionofindustrialproblemsusing linearprogrammingapproach	**K4**

Booksand References:

1. IndustrialEngineeringandProductionManagementbyMartandTTelsangS.ChandPublishing
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,PearsonEducation
10. OperationsResearchbyP.K.GuptaandD.S.Hira,S.Chand&Co.

SubjectCode: BTME506P	HeatandMassTransferLab	LTP:001	Credits:1

COURSEOBJECTIVE

Heattransferandmasstransferarekineticprocessesthatmayoccurandbestudiedseparately or jointly. Studying them apart is simpler, but both processes are modeled by similar mathematical equations in the case of diffusion and convection (there is no mass-transfer similarity to heat radiation), and it is thus more efficient to consider them jointly.

Typical heat-transfer devices like heat exchangers, condensers, boilers, solar collectors, heaters, furnaces, and so on, must be considered in a heat-transfer course, but the emphasis must be on basic heat-transfer models, which are universal, and not on the myriad of details of

ListofExperiments

Minimumeightexperimentofthe following

1. Todeterminethermalconductivityofconductivematerial(s).
2. Todeterminethermalconductivityofinsulatingmaterial(s).
3. Todetermineheatconductionthroughlaggedpipe.
4. Todetermineheattransferthroughfinundernaturalconvection.
5. TodeterminetheheattransferRateandTemperatureDistributionforaPin Fin.
6. Determinationofthermalconductivityofdifferenttypesof fluids.
7. ExperimentonStefan'sLaw -determinationofemissivity, etc.
8. Experimentonconvectiveheattransferthroughflatplatesolar collector.
9. TocompareLMTDandEffectivenessofParallelandCounterFlowHeat Exchangers.
10. TofindtheheattransfercoefficientforForcedConvectionina tube.
11. TofindtheheattransfercoefficientforFreeConvectionina tube.
12. Toconductexperimentsonheatpipe.
13. Tostudytheratesofheattransferfordifferentmaterialsand geometries.
14. VisittoaThermalPowerStationforpracticalexposure.

Thestudentswillbeableto		Blooms Taxonomy
CO1	Applytheconceptofconductiveheattransfer.	K3
CO2	Applyempiricalcorrelationsforbothforcedandfreeconvectiontodetermine thevalueofconvectionheattransfer coefficient	K3
CO3	Applytheconceptofradiationheattransferforblackandgrey body.	K3
CO4	Analyzethethermalbehaviourofparallelorcounterflowheatexchangers	K4
CO5	Conductthermalanalysisofaheatpipe	K4

COMPUTERAIDEDMACHINEDRAWING-IILAB (BTME507P)

SubjectCode: BTME507P	COMPUTER AIDED MACHINE DRAWING-II LAB	LTP:002	Credits:1

CourseObjectives:
Toprovide anoverviewofhowcomputerscanbe utilizedinmechanicalcomponentdesign. Note:All

drawing conforms toBISCodes.

Introduction: Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).

Limits,FitsandTolerances:Generalaspects,Nominalsizeandbasicdimensions,Definitions,Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.

Part Modelling:Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop apart model (Minimum24 machinecomponentsneed to be developed).

PartModelling&Assembliesof:PlummerBlockBearing,MachineVice,ScrewJack,Engine Stuffing box,
Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

CourseOutcomes:
Attheendofthecourse,thestudentwillbeableto:
CO1:Identifythenationalandinternationalstandardspertainingtomachinedrawing.
CO2:Understandtheimportanceofthelinkingfunctionalandvisualizationaspectsinthepreparationofthepart drawings
CO3:Applylimitsandtolerancestoassembliesandchooseappropriatefitsforgivenassemblies. CO4:
Interpret the Machining and surface finish symbols on the component drawings.
CO5:Preparationofthepartorassemblydrawingsasperthe conventions.

BooksandReferences:

1. Textbook ofMachineDrawing,KCJohn,PHI.
2. MachineDrawingby K.R.Gopalakrishna,SubhasStores.
3. ATextbookofMachineDrawingbyPSGillfromS.K.Kataria&Sons.
4. MachineDrawing-KLNarayana,PKannaiah,KV Reddy,NewAgepublications.
5. EngineeringGraphicswithAutoCAD,Bethune,PHI.
6. MachineDrawing,N. Siddeshswar,P Kannaiah,VVSShastry,TataMcGraw Hill.
7. FundamentalsofMachine Drawing,DrSadhuSingh&PLShah,PranticeHallIndia.
8. AutodeskInventorbyExamples,SamTikoo,Wiley.

BTME508-P

AutomobileEngineering.Lab

SubjectCode: BTME508P	**AutomobileEngineering.Lab**	**LTP:002**	**Credits:1**

COURSEOBJECTIVE

Tostudybasicsofprinciplesofactualautomobilesystems.Tostudyimportanceandfeatures ofdifferentsystemslikeaxle,differential,brakes,steering,suspension,andbalancingetc.To studyworkingofvariousAutomobileSystems.Toknowsomemoderntrends inAutomotive Vehicles. Course Outcomes: Course objectives are to be fulfilled

STUDIESTOBECARRIEDOUT(MINIMUMTENEXPERIMENTS)

1. StudyofFrameandChassis.
2. StudyofClutches–SinglePlate,MultiPlateandCentrifugal
3. StudyofGearBoxes–Slidingmesh,Constantmesh,Synchromesh.
4. StudyofDifferential,Universaljoints,AxlesandSlipJoints.
5. StudyofBrakes–Mechanical,Hydraulic,AirBrakeandDiscBrake.
6. StudyofSteeringSystemusedwithRigidAxlesuspensionandindependentsuspensionsystem, Power Steering
7. Studyofdifferenttypesofspringsusedin Automobiles.
8. StudyofRigidAxlesuspensionsystem.
9. StudyofFrontIndependentSuspension System.
10. StudyofReadIndependentSuspensionSystem.
11. StudyofBattery,StaringandGeneratingSystemandBatteryChargingSystem.
12. StudyofAutomotiveElectrical System.
13. StudyofEducationalCar Model.

CO1 Explain and compare the construction, working, feature, relative merits and application of different types of chassis, bodies, frames, clutches and brakes of automobile and use suitable diagram to support their description.

CO2 Explain construction, working and features of different elements of power transmission in automobile namely gear boxes, fluid coupling, hydraulic torque convertor, overdrive, front and rear wheel drive, propeller shaft, differential, power transmission through rear and front axle and automatic transmission system.

CO3 Explain the concept of steering geometry including camber/ caster, king pin inclination, toe in/ toe out, tyre threads and retreading, causes of tyre wear and tear, construction and features of different types of tyres, wheels, steering mechanism and suspension systems with neat sketches as required.

CO4 Explaintheconstruction,featuresandworkingofautomotiveelectricalandelectronicssystemofan automobile and their different parts, namely battery, alternator, starter, ignition systems, electric wiring, head lamps and electric horn.

CO5 Explain the importance and working of automobile air conditioning system and different safety devices suchas Night VisionSystem, GlobalPositioning System, AntilockBraking System, Air Bagsand Beltswithreference to automotive safety requirements.

LISTOFEQUIPMENTS/MACHINES REQUIRED

1. WorkingmodelofSingleplate,Multi-plate&CentrifugalClutch
2. WorkingmodelofActualDifferentialSystem
3. WorkingmodelofUniversalJoint,Axles&SlipJoints
4. WorkingmodelofMechanical,HydraulicandAirBrake
5. WorkingmodelofSteeringSystemusedwithRigidAxlesuspensionSystem
6. WorkingmodelofSteeringSystemusedwithIndependentSuspensionSystem
7. DifferenttypesofSpringsusedinAutomobiles
8. WorkingmodelofRigidAxleSuspensionSystem
9. WorkingmodelofFrontIndependentSuspensionSystem
10. WorkingmodelofRearIndependentSuspensionSystem
11. WorkingmodelofBattery,StaringandGeneratingSystemalongwithChargingunit
12. WorkingmodelofElectrical System
13. CutsectionofActualMasterCylinderofHydraulicBrakeSystem
14. EducationalCarModel

Semester–V:DepartmentalElective–I:Specialization–ManufacturingandAutomation

SubjectCode:BTME504A	ComputerIntegratedManufacturing	LTP:300	Credits:3

CourseObjectives

Todevelop problem-solving skills and apply their knowledge of research and design to create solutions to various challenges. Students will also learn how to document their work and communicate their solutions to their peers and members of the professional community.

Unit1

Introduction to Computer Integrated Manufacturing (CIM): Introduction to CAD, 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–homogeneoustransformations–concatenation, 3D transformations.

Curves: IntroductiontoHermitecubicsplines,Beziercurves,B-splinecurves,NURBS

SurfaceModeling: Polygonsurfaces,Quadricsurfaces,Superquadricsurfacesandblobbyobjects

Solid modeling: Boolean set operations, Primitive instancing, Sweep representation, Boundadry representation, Constructive solid geometry,

Unit3

ComputerAidedManufacturing:

NC in CAM – Principal types of CNC machine tools and their construction features –
tooling for CNC – ISO designation for tooling – CNC operating system

ProgrammingforCNCmachining–coordinatesystems–manualpartprogramming–computerassistedpart 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-tool handling and work handling – machine vision – robot programming concepts – case studies in assembly. Introduction to Programmable logical controller

Unit5

DataandinformationinCIM: ManagementinformationsysteminCIMenvironment,MRP–MRPII–ERP

8. Capacityplanning.

Material handlingin CIM environment: Types – AGVS –AS/RS – Swarf handlingand 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.

CourseOutcome:Studentwillbeableto		**Bloom Taxonomy**
CO 1	Understandthebasicconceptsofautomation,computernumericcontrol machining	K2
CO 2	Understandthealgorithmsoflinegeneration,circlegeneration,transformation, curve,surfacemodelingandsolidmodeling	K2
CO 3	Understandgrouptechnology,computeraidedprocessplanning,flexible manufacturing,Industry4.0, robotics	K2
CO 4	Understandinformationsystemandmaterialhandlinginenvironment,rapid prototyping	K2
CO 5	Applythealgorithmsofline&circlegenerationandgeometrictransformations	K3
CO6	DevelopCNCprogramforsimpleoperations	K3

Booksand References:

1. Mikell P.Groover -Automation , Production Systems and Computer IntegratedManufacturing, Second edition, Prentice Hall of India.

2. IbrahimZeid-CAD/CAM theoryandPractice,TataMcGrawHillPublishingCo.Ltd.,CompanyLtd.,New Delhi.

3. YoramKoren,Controlofmachinetools,McGraw-Hill.

4. Hearn&Baker,ComputerGraphics,PrenticeHallofIndia

5. Sunil Kumar Srivastava, Computer Aided Design: A Basic and Mathematical Approach, I K International Publishing House

6. P.Radhakrishnan,-CAD/CAM/CIM,NewAgeInternational(P)Ltd.,NewDelhi

Semester–V:DepartmentalElective–I:Specialization–AutomationandIndustry

SubjectCode: BTME504B	MechatronicsSystems	LTP:300	Credits:3

CourseObjectives:

The primary objective of mechatronics is to integrate the mechanical systems with electrical, electronics and computersystemsandtoprovideamultidisciplinaryapproachtoproductdevelopmentandmanufacturingsystem design.

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 InductionMotor, 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:MECHATRONICSAPPLICATIONS:

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 pistons and their different combinations, automatic car park system, engine management system, other applications in manufacturing.

CourseOutcome:Studentwillbeableto		**Bloom Taxonomy**
CO 1	Identifykeyelementsofmechatronicsanditsrepresentationbyblockdiagram.	K2
CO 2	Understandtheconceptofsensorsanduseofinterfacingsystems.	K2
CO 3	Understandtheconceptandapplicationsofdifferentactuators	K2
CO 4	Illustratevariousapplicationsofmechatronicsystems.	K2
CO 5	DevelopPLCladderprogrammingandimplementationinreallifeproblem.	K5

Text Books:

5. RolfIsennann,"MechatronicsSystems",Springer, 2005.
6. W.Bolten,"Mechatronics",PearsonEducation2003.
7. HMTLtd,"Mechatronics:,TataMcGrawHill1998.
8. K.P.Ramachandran,G.K.Vijayaraghavan,M.S.Balasundaram,Mechatronics-IntegratedMechanical Electronic Systems, Wiley.

Semester–V:DepartmentalElective–I:Specialization–DesignandAnalysis

SubjectCode:BTME504C	FiniteElementMethods	LTP:300	Credits:3

COURSE Objectives

Tolearnthetheoryandcharacteristicsof**finiteelements**thatrepresentengineeringstructures. To learn and apply **finite element** solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate **finite element** analyses

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 and Equilibrium; Boundary Conditions.

Unit2

Strain-Displacement Relations, Stress–strain relations, Effect of temperature, various approximate methods: weighted residual method, variational or Rayleigh Ritz method, Galerkin's method, 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:finiteelementformulationandcalculationofShearForceandBendingMoment.

Unit5

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

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

CourseOutcome:Studentwillbeableto		**Bloom Taxonomy**
CO 1	UnderstandthebasicconceptsofFEManditsapplications.	K2
CO 2	ApplytheprocedureinvolvedtosolveaproblemusingFiniteElementMethods.	K3
CO 3	Developtheelementstiffnessmatricesusingdifferentapproach.	K3
CO 4	Analyze1Dand2Dproblemusingdifferentmethods.	K4
CO 5	AnalyzethecomplexgeometricproblemsthroughFEMsoftwarepackages.	K4

Text Books:

1. Chandrupatla, T. R. and Belegundu, A. K., Introduction to Finite Elements in Engineering, Pearson Education, India (2001).
2. Rao,S.S.,Finiteelementmethodinengineering,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: BTME504D	ICEngineFuelandLubricants	LTP:300	Credits:3

Courseobjectives

To give an overview of Internal Combustion Engines, their classification, applications, operation and processes. 2. To give complete knowledge of type of fuels used in IC engines and the fuel supply system.

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.

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

Unit–II **(7Hours)**

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay,Abnormal combustion and its control.

Combustionchamber:Squish,Swirl&tumble,CombustionchamberdesignforSI&CIengine&factorsaffectingit.

Unit–III **(8Hours)**

Carburetion,Mixturerequirements,CarburetorsandfuelinjectionsysteminSIEngine,MPFI,Scavengingin2 Stroke engines.

FuelinjectioninCIengines,Requirements,Typesofinjectionsystems,Fuelpumps,Fuelinjectors,Injectiontimings.

Turbocharging & its types-Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect of turbocharging on power & emission.

Unit-IV **(9Hours)**

Engine Emission and Control: Pollutant-Sources and types – Effect on environment and human health-formation ofNOx-HydrocarbonEmissionMechanism-CarbonMonoxideFormation-Particulateemissions-Methodsof

controllingEmissions- CatalyticconvertersandParticulateTraps- SelectiveCatalyticReduction(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 enginefuels, 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 timingand spark plug, Electronic ignition.

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

CO	**CourseOutcome**	**Bloom Taxonomy**
CO 1	Explaintheworkingprinciple,performanceparametersandtestingofICEngine.	K2
CO 2	UnderstandthecombustionphenomenainSIandCIenginesand factors influencingcombustionchamberdesign.	K2
CO 3	UnderstandtheessentialsystemsofICengineandlatesttrendsand developments inIC Engines.	K2
CO 4	Understandtheeffectofengineemissionsonenvironmentandhumanhealthand methodsofreducing it.	K2
CO 5	Applytheconceptsofthermodynamicstoairstandardcycle inICEngines	K3
CO 6	AnalyzetheeffectofvariousoperatingparametersonICengine performance.	K4

Text Books

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

ReferenceBooks

- I.CEngineAnalysis&PracticebyE.F Obert.
- InternalCombustionEngineFundamentals,byJohnB.Heywood,TataMcgrawHillPublishers.
- EngineEmission,byB.B.Pundir,NarosaPublication.
- EngineeringFundamentalsofInternalCombustionEnginesbyW.W.Pulkrabek,PearsonEducation.
- FundamentalsofInternalCombustionEnginebyGill,Smith,Ziurs,Oxford&IBHPublishingCO.
- FundamentalsofInternalCombustionEnginesbyH.N.Gupta,PrenticeHallof India.

Semester–V:DepartmentalElective–I:Specialization–AutomobileEngineering

SubjectCode: BTME504E	AutomobileEngines&Combustion	LTP:300	Credits:3

Course Objectives:1Togive anoverviewof InternalCombustion Engines,theirclassification, applications,operation and processes. 2. To give complete knowledge of type of fuels used in IC engines and the fuel supply systems 3. To describe combustion phenomena in IC engines 4 To explain the different performance analysis of IC engines 5. To explain the effects of exhaust emission on human health and various pollution norms 6. To explain the Gas Turbine with various operating cycles.

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 andCI engines.

Unit–II

CombustionandFlames Propagation:

(8Hours)

Chemical composition– Flue gas analysis, Dew point of products, Stoichiometry, Stoichiometry relations, theoretical air required for complete combustion, Enthalpy of formation, Heating value of fuel, Adiabatic flame Temperature, Chemical equilibrium.

Flame stability, Burning velocity 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: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay,Abnormal combustion and its control.

Combustionchamber:Squish,Swirl&tumble,CombustionchamberdesignforSI&CIengine&factorsaffectingit.

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,CarburetorsandfuelinjectionsysteminSIEngine,MPFI,Scavengingin2 Stroke engines.

FuelinjectioninCIengines,Requirements,Typesofinjectionsystems,Fuelpumps,Fuelinjectors,Injectiontimings.

Turbocharging & its types-Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect of turbocharging on power & emission.

UNIT-V **(8Hours)**

EngineEmissionandControl:Pollutant -Sourcesandtypes–Effectonenvironmentandhumanhealth -formationof 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.

CO	CourseOutcome	Bloom Taxonomy
CO1	Explaintheworkingprinciple,performanceparametersandtestingofICEngine.	K2
CO2	Understandthephenomenaofcombustionanditsapplicationin SIandCI engines.	K2
CO3	UnderstandtheessentialsystemsofIC engine.	K2
CO4	Understandtheeffectofengineemissionsonenvironmentandhumanhealthand methodsofreducing it.	K2
CO5	Applytheconceptsofthermodynamicstoairstandardcycle inICEngines	K3
CO6	AnalyzetheeffectofvariousoperatingparametersonICengine performance.	K4

Text Books

- ACourseinInternationalCombustionEngines,byMathur&Sharma,DhanpatRai&Sons.
- Fuelsandcombustion,SharmaandChanderMohan,TataMcGraw Hill
- I.CEngine,byGaneshan,TataMcGrawHillPublishers.

ReferenceBooks

6. I.CEngineAnalysis&PracticebyE.F Obert.
7. InternalCombustionEngineFundamentals,byJohnB.Heywood,TataMcgrawHillPublishers.
8. EngineEmission,byB.B.Pundir,NarosaPublication.
9. EngineeringFundamentalsofInternalCombustionEnginesbyW.W.Pulkrabek,PearsonEducation.
10. FundamentalsofInternalCombustionEnginebyGill,Smith,Ziurs,Oxford&IBHPublishingCO.
11. FundamentalsofInternalCombustionEnginesbyH.N.Gupta,PrenticeHallof India.

Semester–V:DepartmentalElective–II:Specialization–ManufacturingandAutomation

SubjectCode: BTME505A	AdvanceWelding	LTP:300	Credits:3

Courseobjectives

The objective of this course is To learn various concepts related to welding,its application To have practical purview of various welding process, welding standards, advanced welding process

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 Reclamationwelding.

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

UNIT-V:

WeldDesign: Typesofwelds&joints,WeldingSymbols,WelddefectsandRemedies,ResidualStresses

2.Distortion,Inspectionandtestingofwelds:IntroductiontoNonDestructiveTechniques;DestructiveTechniques-BulkandMicrohardnesstest,Weartestandtypes,corrosiontest,tensiletest,bendtest,SEM,EDSand XRD.

WeldingCodes,WPS&PQR: Introductiontoweldingcodes,ISO,ASMEandBISspecifications,Welding ProcedureSpecification(WPS)&ProcedureQualificationRecord(PQR),Weldingofpipe-linesandpressure vessels.

CourseOutcome:Studentwillbeableto		**Bloom Taxonomy**
CO 1	Understandthephysicsofarcweldingprocessandvariousoperatingcharacteristics of welding power source.	K2
CO 2	Analysevariousweldingprocessesandtheir applications.	K3
CO 3	Applytheknowledgeofweldingforrepair&maintenance,alongwiththe weldability of different materials.	K3
CO 4	Applytheconceptofqualitycontrolandtestingofweldmentsin industrial environment.	K3
CO 5	Evaluateheatflowinweldingandphysicalmetallurgyofweldments.	K4

Booksand References:

5. WeldingandWeldingTechnology,by-RichardL.Little,McGrawHillEducation.
6. WeldingPrincipalsandPractices,by-EdwarsR.Bohnart,McGrawHillEducation.
7. WeldingEngineeringandTechnology,by-R.S.Parmar,KhannaPublishsers.
8. WeldingTechnologyFundamentalsbyWilliam.A.Bowditch.
9. WeldingTechnologybyNK Srinivasan.
10. WeldingEngineeringandTechnologybyRSParmar.
11. ModernWeldingTechnologybyHowardBCaryandScottHelzer.
12. WeldingHandbooks(Vol.I&II)
13. AdvancedWeldingProcesses,Woodheadpublishing,J.Norrish
14. ASMESec.IX,Boiler andPressureVesselCode

Semester–V:DepartmentalElective–II:Specialization–AutomationandIndustry4.0

SubjectCode: BTME505B	Programming,DataStructuresAndAlgorithms UsingPython	LTP:300	Credits:3

Courseobjectives

- RecognizePopularDataStructuresandAlgorithms.Mostcomputerprogramsarebasedonafewdata structures and algorithms.
- LearntoSpotDataStructuresandAlgorithmsinEverydayLife.
- AnalyzetheEfficiencyofAlgorithms.
- SharpenYourPythonProgrammingKnowledge.

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:DataStructure (7Hours)

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

UNIT3:FunctionandFile Handling (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:Classesand Object (8Hours)

Generatingpermutations,Stack,Queue,CircularQueue,Abstractdatatypes,classesandobjects,Classesand 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.

CourseOutcome:Studentwillbeableto	Bloom Taxonomy

CO 1	Understandthenumbers,math'sfunction,strings,list,tuples,anddictionariesin pythons	K2
CO 2	Applyconditionalstatementandfunctionsinpython	K3
CO 3	Applyfilehandlingtechniquesinpython	K3
CO 4	Analyzethegraphicaldemonstrationinpython	K4
CO 5	ApplytechniquesofClassesandObjectConceptinPython	K3

ReferenceBooks:

4. GuidovanRossumandFredL.DrakeJr,AnIntroductiontoPython–RevisedandupdatedforPython3.2, Network Theory Ltd., 2011

5. AllenB. Downey,"ThinkPython:HowtoThinkLike aComputer Scientist, 2ndedition, Updatedfor Python3, Shroff/ OReilly Publishers, 2016

6. RobertSedgewick,KevinWayne,RobertDondero,IntroductiontoProgramminginPython:AnInter-disciplinaryApproach,PearsonIndiaEducationServicesPvt.Ltd., 2016

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

SubjectCode:BTME505C	MechanicalVibrations	LTP:300		Credits:3

CourseObjectives

- Toimpartknowledgeaboutthebasicconceptsandprinciplesofvibrationinmechanicalsystems.
- Tointroducethefundamentalsofvarious materials.
- Toenablethestudentstounderstandbasicprincipleofnoise engineering.

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, andacceleration 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 **(10 Hours)**

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-discshafts,Secondarycritical speed.

Industrialcasestudies(anytwo)involvingmechanicalvibrations,theirimpactandperformanceanalysis.

IntroductiontothevibrationanalysisusingMATLAB.

Booksand References:

i. MechanicalVibrations-V.P.Singh,Dhanpatrai&Co.
ii. MechanicalVibrations-G.K.Grover,JainBrothers, Roorkee.
iii. MechanicalVibrations-Kelly
iv. MechanicalVibrations-Tse,Morse&Hinkle
v. **Case study Reference#1**: https://www.ijstr.org/final-print/july2018/Vibration-Analysis-Of-Rotating-Machines-With-Case-Studies.pdf
vi. **CasestudyReference#2:** https://www.researchgate.net/publication/254227083_Case_studies_of_vibrations_in_structures
vii. **Case study Reference#3:** https://pdfs.semanticscholar.org/f2b6/39990c4ba52706f43d02fe1c59b9c3fabf2a.pdf
viii. **MOOC reference:**https://www.youtube.com/playlist?list=PLSGws_74K01_pG3R7rgtDtrDZBjcTgPdR

Recommendedsoftwarepackages:

1. MATLAB
2. AnymodellingandFEAtoollikeNX,Solidworksetc.

CourseOutcome:Studentwillbeableto		**Bloom Taxonomy**
CO 1	Understandfundamentalsofmechanicalvibrationsalongwiththeir classification.	K2
CO 2	Differentiateamongsingle,twoandmultipledegreeoffreedom(DOF)systems.	K3
CO 3	Analyze,predictandmeasuretheperformanceofsystemsundergoingsingle,two andmultiple DOF.	K4
CO 4	Designsystemswithoptimizedvibrationabsorptioncapabilities.	K4
CO 5	Applythefundamentalstothereallifeproblemslikewhirlingof shaft	K3
CO 6	SolvecomplicatedmathematicalmodelsusingNumericalmethodsandsoftware	K4

Semester–V:DepartmentalElective–II:Specialization–ThermalEngineering

SubjectCode: BTME505D	Fuelsand Combustion	LTP:300	Credits:3

Courseobjectives

The objective is to introduce the use and the application of different fuel typesand characteristics. The student will be able to understand various fuel handling and storage methods. FUELS: Detailed classification –Conventional and Unconventional Solid, Liquid, gaseous fuels and nuclear fuels –Origin of Coal – Analysis of coal. Coal –Carburization, Gasification and liquefaction –Properties of coal, action of heat on coal, oxidation of coal, hydrogenation of coal, efficient use of solid fuels, manufactured fuels, agro fuels, solid fuel handling, properties related to combustion, handling and storage.

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 storage of coal-Renewable Solid Fuels comparative studyof Solid, liquidand gaseousfuels-selection ofcoal for different industrialapplications-carbonization of coal

Unit-II

LiquidFuels:

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

GaseousFuels:

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:CombustionandFlames Propagation

Chemicalcomposition–Fluegasanalysis,Dewpointofproducts,Stoichiometry,Stoichiometryrelations, theoretical air required for complete combustion, Enthalpy of formation, Heating value of fuel, Adiabatic flame Temperature, Chemical equilibrium.

Flamestability,Burningvelocityoffuels,Measurementofburningvelocity,Factorsaffectingtheburning velocity, Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion, Flame Temperature– Theoretical, Adiabatic & Actual, Ignition Limits, Limits of Inflammability.

Unit-IV:CombustionEquipment

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 affecting burners and combustion, Combustion in I.C. Engines, Combustion in gas turbine and jet engines

Unit-V:AirPollution

Typesofpollution,Combustiongeneratedairpollution,Effectsofairpollution,Pollutionoffossilfuelsand its control, Pollution from automobiles and its control, Emission by diesel engines, Emission Standards.

	Thestudentswillbeableto	**Blooms Taxonomy**
CO1	Understandthepropertiesofdifferenttypesoffuelwiththeirapplication.	K2
CO2	Classifydifferent typesoffuels.	K2
CO3	Understandtheconceptofcombustion.	K2
CO4	Understandthefundamentalconceptofairpollutionandits control.	K2
CO5	Calculatevariouspropertiesofthefuels.	K3
CO6	Analyzethefluegases.	K4

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

4. SpeightJ.G.,TheChemistryandTechnologyofCoal,3rded.,TaylorandFrancisLtd.,USA,2016

5. SarkarS.,Fuelsandcombustion,3rded.,UniversitiesPress,India, 2009

Semester–V:DepartmentalElective–II:Specialization–AutomobileEngineering

SubjectCode: BTME505E	Automotivechassisandsuspension	LTP:300	Credits:3

Courseobjectives:

Theobjectivesofthiscourseisto

1. Explain different chassis layouts and frames solve for stability and weight distribution and suitability of frames.
2. Describe,aboutvariousFrontAxles,factorsofwheelalignmentSteeringSystemsandCalculatedimensions of Front Axle.
3. DiscussaboutvarioustypesPropellerShaft,DifferentialAndRearAxlesandtosolvenumerical.
4. ComparevarioustypesofBrakesandsolvenumerical.
5. DescribeVariousTypesofSuspensions,WheelsandTires.
6. Calculatedimensionsofdifferentsuspensions.

UnitI

ChassisLayoutsandFrames

DefinitionofChassis,TypesofChassisLayoutwithreferencetoPowerPlantLocationand Drive

Automotive Frames - Material Selection and its Constructional Details, Various types, Different Loads acting on Frame, Testing of Automotive Frames.

UnitII

Transmission: Clutches-Requirements and its types, Gear Box: Need and requirements, Types of manual 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.

BrakingSystems: StoppingDistance,BrakingEfficiency,WeightTransferduringBraking,DrumBrakes - Constructional Details,LeadingandTrailingShoe,BrakingTorque,DiscBrake -TypesandConstructional Details, Hydraulic Braking System, Pneumatic Braking System, Power–Assisted Braking System, Factors affectingbrakeperformance,operatingtemperature,Areaofbrakelining, 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

SteeringSystem: TypesofFrontAxlesandStubAxles,FrontWheelGeometry,ConditionforTrueRolling 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.

CourseOutcomes:Thestudentswillbeableto		**Blooms Taxonomy**
CO-1	Understanddifferent typesofautomotivechassisand framesusedin automobiles.	K2
CO-2	Understandtransmissionanddrivelinecomponentsusedinautomobile.	K2
CO-3	Understandtheaxlesandtypesofsteeringsystemin automobile.	K2
CO-4	Understandtheconstructionalfeaturesofbarking,suspensionsystem,wheels andtyresinautomobile application.	K2
	Understandtherecentadvancementsmadeinchassis componentsof	K2

CO-5	automobile.		
CO-6	Apply the concepts of b application.	rakingandsteeringsystemtodesignthesameforautomobile	K3

Text Books:

11. Automobileengineering",Dr.KripalSingh.
12. 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

MiniProjectorInternship Assessment*

SubjectCode: BTME509P

SubjectCode: BTME509P	MiniProjectorInternshipAssessment*	**LTP:002**	**Credits:2**

Courseobjectives

Todevelopskillcompetenciesspecifictoanoccupationorprofession.

Toexpandoralandwrittencommunicationskills.Culturesandtoworkeffectivelywithindiverse environments.

Toacquireadditionalinterpersonalcommunicationandinteractionskills.

CourseOutcome:Attheendofthiscourse,studentswillbeableto:

1. Studentswillbeabletopracticeacquiredknowledgewithinthechosenareaoftechnologyforproject development.

2. Identify,discussandjustifythetechnicalaspectsofthechosenprojectwithacomprehensiveandsystematic approach.

3. Reproduce,improveandrefinetechnicalaspectsforengineeringprojects.

4. Workasanindividualorinteamindevelopmentoftechnicalprojects.

5. Communicateandreporteffectivelyprojectrelatedactivitiesandfindings.

Semester-VI

SubjectCode:BTME601	Refrigeration&AirConditioning	LTP:310	Credits:4

COURSEOBJECTIVES

Ithelpsthestudentstounderstandtheconceptsandusesofvarioustypesofrefrigeration systems and equipments.
Thestudentwillbeabletoestimatetheheating/coolingloadanddesignairconditioning system and equipments.

Unit-1
Refrigeration: 8Hours

Introduction to refrigeration system, Methods of refrigeration, Unit of refrigeration, Refrigeration effect, Carnot refrigeration cycle, Refrigerator and Heat Pump, C.O.P.

AirRefrigerationcycle:

Open and closed air refrigeration cycles, Reversed air Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Need of Aircraft refrigeration, Classification ofaircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dryair 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 pressuresonC.O.P,EffectofsubcoolingofcondensateandsuperheatingofrefrigerantvapouronC.O.Pofthecycle, 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

VapourAbsorptionsystem;

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentrationdiagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium-Bromide water vapour absorption system, Comparison, Three fluid syst **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**8 Hours**

Unit-4

AirConditioning:

8 Hours

Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometricprocesses,AirWashers,Coolingtowers&humidifyingefficiency,Thermalanalysisofhumanbody,
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

RefrigerationSystemEquipment:

8 Hours

Compressors,Condensers,ExpansionDevicesandEvaporators,Elementaryknowledgeoftransmissionanddistribution 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:

Cryogenicliquefactionandrefrigerationsystems, Brief introductionof Thermo-electric refrigerationsystem, Steam jet refrigeration system, Vortex tube refrigeration system, Magnetic refrigeration system.

Thestudentswillbeableto		**Blooms Taxonomy**
CO1	Understandthebasics concepts ofRefrigeration &Air-Conditioning anditsfuture prospects.	K2
CO2	Explaintheconstructionandworkingofvariouscomponentsin Refrigeration& Air-Conditioningsystems.	K2
CO3	UnderstandthedifferenttypesofRACsystemswiththeirrespectiveapplications.	K2
CO4	Applythebasiclawstothethermodynamicanalysisofdifferent processes involvedinRefrigerationandAir-Conditioning.	K3
CO5	ApplythebasicconceptstocalculatetheCOPandotherperformance parametersfordifferentRACsystems	K3
CO6	Analyzetheeffectsofperformanceparameterson COP.	K4

ReferenceBooks:

3RefrigerationandAirconditioningbyC.PArora,McGraw-Hill
4RefrigerationandAirconditioning,byManoharPrasad,NewAgeInternational(P)Ltd.Pub.
1. RefrigerationandAirconditioningbyR.C.Arora,PHI

6. PrinciplesofRefrigerationbyRoyJ.Dossat.Pearson Education
7. RefrigerationandAirconditioningbyStoecker&Jones.McGraw-Hill
8. RefrigerationandAirconditioningbyArora&Domkundwar.DhanpatRai
9. ThermalEnvironmentEngineering.ByKuhen,Ramsey&Thelked
em.

SubjectCode:BTME602	MachineDesign	LTP:310	Credits:4

COURSEOBJECTIVE

Theobjectivesofthiscoursearetocoverbasicsofdesignprocess;engineeringmaterials;failurepreventionunder static loadings and characteristics of a few types of mechanical elements like joints – temporary / permanent etc

UnitI **8Hours**

Introduction

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

DesignagainstFluctuatingLoads

Cyclicstresses,Fatigueandendurancelimit,Stressconcentrationfactor,Stressconcentrationfactorforvarious machine parts, Design for finite & infinite life, Soderberg, Goodman, Gerber criteria

UnitII

RivetedJoints8Hours

Rivetingmethods,materials,Typesofrivetheads,Typesofrivetedjoints,CaulkingandFullering,Failureof 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 parallel fillet 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

SpurGears

8 Hours

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears,Backlash,Selectionofgearmaterials,Gearmanufacturingmethods,Designconsiderations,Beamstrengthof gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of 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.

Introduction,ClassificationandApplicationsofBevel&Worm Gears

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

ICEngine Parts

SelectionoftypeofICengine,Generaldesignconsiderations,DesignofCylinderandcylinderhead;Designof piston, piston ring and gudgeon pin;

FrictionClutches

Clutches,Differencebetween couplingandclutch,Singleplatefrictionclutch,Torquetransmittingcapacity,Multi-DiskClutches,FrictionMaterial

Note:Designdatabookisallowedintheexamination

CourseOutcomes:Thestudentwillbeableto		**Blooms Taxonomy**
CO 1	RecallthebasicconceptsofSolidMechanicstounderstandthesubject.	**K2**
CO 2	Classifyvariousmachineelementsbasedontheirfunctionsand applications.	**K2**
CO 3	Applytheprinciplesofsolidmechanicstomachineelementssubjectedtostatic andfluctuatingloads.	**K3**
CO 4	Analyzeforces,bendingmoments,twistingmomentsandfailurecausesinvarious machineelementstobedesigned.	**K4**
CO 5	Designthemachineelementstomeettherequired specification.	**K5**

Text Books:

8:DesignofMachineElements-V.B.Bhandari,TataMcGrawHillCo.
9:Design of Machine Elements, Sharma and Purohit, PHI.

ReferenceBooks:

(vi) MechanicalEngineeringDesign,9e–JosephE.Shigely,McGrawHillEducation.
(vii) MachineDesign-MaleevandHartman,CBS Publishers.
(viii) DesignofMachineDesign-M.F.Spott,PearsonEducation.
(ix) ElementsofMachineComponentDesign,Juvinal&Marshek,JohnWiley&Sons.
(x) Machinedesign,RobertL.Norton,PearsonEducation
(xi) Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGrawHill Co.
(xii) MachineDesign-SharmaandAgrawal,S.K.Kataria&Sons.
(xiii) MachineDesign,UCJindal,Pearson Education.

SubjectCode:BTME603	Theoryof Machines	LTP:310	Credits:4

Courseobjectives

1 Toidentifyandenumeratedifferentlinkbasedmechanismswithbasicunderstandingofmotion

2. Tointerpretandanalyzevariousvelocityandaccelerationdiagramsforvariousmechanisms
3. Tounderstandandillustratevariouspowertransmissionmechanismsusingsuitablemethod

UnitI **(09Hours)**

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their 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.

Accelerationanalysis: Introduction, accelerationof apoint onalink, accelerationdiagram, Corioli's component of acceleration, crank and slotted lever mechanism,.

UnitII **(10Hours)**

Cams: Introduction,classificationofcamsandfollowers,camprofilesforknifeedge,rollerandflatfacedfollowers 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 on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

UnitIII **(08Hours)**

Force analysis: Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane 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(09 Hours)

Brakes and dynamometers: Introduction, Law of friction and types of lubrication, types of brakes, effectof 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.

CourseOutcomes:Thestudentswillbeableto		**Blooms Taxonomy**
CO1	Understandtheprinciplesofkinematicsanddynamicsofmachines.	K2
CO2	Calculatethevelocityandaccelerationfor4-barandslider crankmechanism	**K3**
CO3	Developcamprofileforfollowersexecutingvarioustypesofmotions	K3
CO4	Applytheconceptofgear,geartrainandflywheelforpowertransmission	K3
CO5	Applydynamicforceanalysisforslidercrankmechanismandbalancerotating& reciprocatingmassesin machines.	K3
CO6	Applytheconceptsofgyroscope,governorsinfluctuationofloadandbrake& dynamometerinpowertransmission	K3

Text/ReferenceBooks

10. Kinematicsanddynamicsofmachinery:WilsonandSadler,Thirdedition,Pearson.

11. TheoryofMechanismsandMachines:AmitabhGhoshandAshokKumarMallik,ThirdEditionAffiliatedEast-WestPress.
12. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford UniversityPress

13. Kinematicsanddynamicsofmachinery:RLNorton,McGrawHill
14. TheoryofMachines:S.S.Rattan,McGrawHill
15. TheoryofMachines:ThomasBevan,CBS Publishers.

SuggestedSoftware

MechAnalyzer

SubjectCode:BTME606P	Refrigeration&AirConditioning Lab	LTP:002	Credits:1

COURSEOBJECTIVES

Refrigerationandair-conditioningsubjectisanapplicationbasedengineeringtopic.Its applicationcanbeseenininduстries of MechanicalandChemical engineering.Roleof refrigeration and air-conditioning:

Foodprocessing,preservationanddistribution

Chemical and process industries

Comfortair-conditioninginaircraftandship

Minimumeightexperimentsoutofthe following:

1. Experimentonrefrigerationtestrigandcalculationofvariousperformanceparameters.
2. Experimentonair-conditioningtestrig&calculationofvariousperformanceparameters.
3. StudyofPsychrometeranddeterminationofhumidityofairusingSling Psychrometer.
4. Tostudyandperformexperimentonvapourabsorptionapparatus.
5. Tostudytheairwasherandperformdifferentpsychometricprocessesonairwasher.
6. Studyofdesertcoolersanddeterminethechangeintemperatureandhumidityofambientair.
7. Handling, use and familiarization with refrigeration tools and accessories such as: Tube cutter; Tube bender [spring type]; Flaring tool; Swaging tool; Pinch off etc.
8. Studyofwindowairconditioner.
9. StudyofHermeticallysealedcompressor.
10. Tostudybasiccomponentsandcontroldevicesofrefrigerationandair-conditioningsystem.

11. ExperimentonIce-plantandcalculationofvariousperformanceparameters.
12. Visitofacentralairconditioningplantanditsdetailedstudy.
13. Visitofcold-storageanditsdetailedstudy.

Thestudentswillbeableto:		**Blooms Taxonomy**
CO1	Determinetheperformanceofdifferent refrigerationand air-conditioningsystems.	K3
CO2	Apply theconceptofpsychrometryondifferentaircoolingsystems.	K3
CO3	InterprettheuseofdifferentcomponentsControlsystemsandtoolsusedinRAC systems	K3
CO4	DemonstratetheworkingofpracticalapplicationsofRACsystems.	K2

SubjectCode:BTME607P	MachineDesignLab	LTP:002	Credits:1

COURSEOBJECTIVES

To learn the basic concepts and to draw the views of section of solids, orthographic projections and threadedfasteners.•Thiscoursewillgivetheinsightintothedesign,creationofassemblyandgetthe detailed drawing of machine components. • This course will also introduce students to draw riveted joints, threaded fasteners and couplings

A DesignofMachine Elements

5. Designaknucklejointsubjectedtogiventensileload.
6. Designarivetedjointsubjectedtogiveneccentricload.
7. Designofshaftsubjectedtocombinedconstanttwistingandbending loads
8. Designatransversefilletweldedjointsubjectedtogiventensile load.
9. Design&selectsuitableRollingContactBearingforashaftwithgiven specifications
10. DesignacylinderheadofanICEnginewithprescribedparameters.
11. DesignofPiston&itspartsofanIC Engine

B.ComputerProgramsforconventionaldesign

ComputerandLanguage: StudentsarerequiredtolearnthebasicsofcomputerlanguagesuchasC/C++/MATLABsothattheyshouldbeabletowritethecomputerprogram.

12. DesignapairofSpurGearwithgivenspecificationstodetermineitsvariousdimensionsusing Computer Program in C/C++.
13. DesignapairofHelicalGearwithgivenspecificationstodetermineitsvariousdimensionsusing Computer Program in C/C++.
14. DesignofSlidingContactBearingwithgivenspecifications&determineitsvariousparametersusing Computer Program in C/C++.

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

SubjectCode:BTME608P	TheoryofMachinesLab	LTP:002	Credits:1

COURSEOBJECTIVES

1. To equip students with understanding of the fundamental principles and techniques for Identify differenttypesofdynamicsystemsandclassifythembytheirgoverningequations.2.Todevelopa model of a mechanical system using a free body diagram. 3. To develop equations of motion for translationalandrotationalmechanicalsystems.Measurementofmomentofinertiaofrigidbodies. Gyroscope. Jump speed of a cam. Mechanical vibrations. Balancing

ListofExperiments

(Minimumeightexperimentsoutofthefollowing**)**

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

1. Tostudyvarioustypesofkinematicslinks,pairs,chains&Mechanisms
2. TostudyWhitworthQuickReturnMotionMechanisms,ReciprocatingEngineMechanism,andOscillating Engine Mechanism
3. Tostudyofinversions offourbar linkage
4. Tostudyofinversionsofsingle/doubleslidercrankmechanisms
5. Tostudyvarioustypesofgear(Helical,crosshelical,worm,bevelgear)andgearprofile(involuteand cycloidal) and condition for interference Helical, cross helical, worm, bevel gear
6. Tocomputetheoutputvelocityinvariousgear trains
7. Tostudygyroscopiceffectsthrough models
8. TodeterminegyroscopiccoupleonMotorizedGyroscope
9. To perform experiment on dead weight type governor to prepare performance characteristic Curves, and to find stability & sensitivity
10. To perform experiment on spring controlled governor to prepare performance characteristic Curves, and to find stability & sensitivity
11. Todeterminewhirlingspeedofshafttheoreticallyandexperimentally
12. Toperformtheexperimentforstatic/dynamicbalancing

13. Toperformexperimentonbrake
14. Toperformexperimentonclutch
15. Toperformtheexperimentforstatic/dynamicbalancing.
16. Toperformexperimentonlongitudinalvibration
17. Toperformexperimentontransversevibration

Thestudentswillbeableto:		**Blooms Taxonomy**
CO1	Demonstratevariousmechanisms,theirinversionsandbrakeandclutchesin automobiles	K2
CO2	Applycam-followermechanismtogetdesiredmotionoffollower.	K3
CO3	Applytheconceptsofgearsandgeartraintogetdesiredvelocityratioforpower transmission.	K3
CO4	Applytheconceptofgovernorstocontrolthefuelsupplyin engine.	K3
CO5	Determinethebalancingloadinstaticanddynamicbalancing problem	K3

Semester–VI:DepartmentalElective–III:Specialization–ManufacturingandAutomation

SubjectCode:BTME604A	NondestructiveTesting	LTP:300	Credits:3

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Courseobjectives

: To provide knowledge and enrich ideas about the conventional NDT techniques and develop a strong hands onexperience for inspecting and evaluating components in accordance with industry specifications.

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 detectingsurfacedefectsandtheirinterpretation,advantages&limitationsofvisualinspection,VisualInspectionin Welding

Unit-II:

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

Magnetic Particle Inspection – Principle, Scope, Testing equipment, Advantages, Limitations, Application ofMPI & 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-rayradiographyoverX-rayradiography. Precautions against radiation hazards.

Unit-IV:

Ultrasonic Testing– Introduction, Principle, Piezoelectricity and Piezoelectric Transducers, Wavepropagation,

Ultrasonicprobes,selectionofangleprobes,AcousticImpedance,Reflectionandtransmissioncoefficient,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. Introductionto 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.

Acoustic Emission Technique– Introduction, Types of AE signal, Principle, Advantages & Limitations, Interpretation of Results, Applications.

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

CourseOutcome:Studentwillbeableto		**Bloom Taxonomy**
CO 1	Understandtheconceptofdestructiveand Non-destructivetestingmethods.	K2
CO2	Explaintheworkingprincipleandapplicationofdiepenetranttestandmagnetic particleinspection.	K2
CO3	Understandtheworkingprincipleofeddycurrentinspection.	K2
CO 4	Applyradiographictechniquesfor testing.	K3
CO 5	ApplytheprincipleofUltrasonictestingandapplicationsinmedicalandengineering areas.	K3

Booksand References:

6. Non-DestructiveTestingandEvaluationofMaterials,by-Prasad,McGrawHill Education.
7. PracticalNon-destructiveTesting,by-BaldevRaj,T.Jayakumar,M.Thavasimuthu,WoodheadPublishing.
8. Non-DestructiveTestingTechniques,by-RaviPrakash,NewAgeInternational.
9. NondestructiveTestingHandbook,byRobertC.McMaster,AmericanSocietyfor Nondestructive.
10. IntroductiontoNondestructiveTesting:ATrainingGuide,by-PaulE.Mix,wiley.
11. ElectricalandMagneticMethodsofNon-destructiveTesting,by-J.Blitz,springer.
12. PracticalnondestructivetestingbyRaj,Baldev.
13. BasicsofNon-DestructiveTesting,byLari&Kumar,KATSONBooks.
14. ASMESec.V,boilerandpressurevessel code

Semester–VI:DepartmentalElective–III:Specialization–AutomationandIndustry4.0

SubjectCode: BTME604B	ArtificialIntelligence	LTP:300	Credits:3

Courseobjectives

Themainlearningobjectivesofthecourseareto: Identifyproblemswhereartificialintelligencetechniquesare applicable. Apply selected basic AI techniques; judge applicability of more advanced techniques.

(9Hours)

Unit1:

Introduction of Artificial Intelligence, Intelligent Agents,andBehaviors 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 Early Vision,UsingVisionforManipulationandNavigation,SpeechRecognition.Robotics:Tasks:WhatAreRobots Good For? Parts: What Are Robots Made Of? Architectures, Configuration Spaces: A Framework for Analysis, Navigation and Motion Planning

CourseOutcomes:Studentsareable to		**Bloom's Taxonomy**
CO 1	UnderstandconceptsofArtificialIntelligence	**K2**
CO 2	Solveproblem bySearch-I&Search-II	**K3**
CO 3	UnderstandKnowledgerepresentation	**K2**
CO 4	ApplyconceptsofLearning methods	**K3**
CO 5	AnalyseDecisionNetworks	**K4**
CO 6	Buildplanning graphs	**K5**

Text Book:

StuartRussell,PeterNorvig,"ArtificialIntelligence–AModernApproach",PearsonEducation

ReferenceBooks:

1. ElaineRichandKevinKnight,"ArtificialIntelligence",McGraw-Hill
2. ECharniakandDMcDermott,"IntroductiontoArtificialIntelligence",PearsonEducation
3. DanW.Patterson,"ArtificialIntelligenceandExpertSystems",PrenticeHallof India,

Semester–VI:DepartmentalElective–III:Specialization–Designand Analysis

SubjectCode: BTME604C	Tribology	LTP:300	Credits:3

CourseObjectives

1. ToprovidetheknowledgeandimportanceofTribologyinDesign,friction,wearandlubricationaspectsof machine components.
2. Toselectpropergradelubricantforspecificapplication.
3. Tounderstandtheprinciplesoflubrication,lubricationregimes,theoriesofhydrodynamicandtheadvanced lubrication techniques.
4. Tointroducetheconceptofsurfaceengineeringanditsimportancein tribology.
5. TounderstandthebehaviorofTribologicalcomponent

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 –IIFriction andWear

Friction-causesoffriction,theoriesofdryfriction;adhesiontheory,abrasivetheory,junctiongrowththeory,lawsof rolling friction, friction measurement, friction instabilities.

Wear-classification; abrasive wear, erosive wear, cavitation wear, adhesive wear, corrosive wear, oxidative wear, fatiguewear,factorsaffectingwear,measurementofwear,theoriesofwear,approachestofrictioncontrolandwear prevention.

UNIT –IIILubrication of Bearings

Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, jet lubrication, mist lubrication, lubricationutilizingunderracepassage,concept of journalbearing,minimumoilfilmthickness, 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 metallicfilms, deposition methods of solid lubricants, techniques for producing wear resistant coatings, characteristics of wear resistant coatings.

UNIT–VFriction,LubricationandWearinKinematicpairs

The concept of friction angle, friction stability, friction in slideways, friction in screws with square threads, friction inscrewswithtriangularthreads,mechanismandoperationofplateclutch,coneclutch,rimclutch,centrifugal

clutch, and belt drives, tribodesign 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.

CourseOutcome:Studentwillbeableto		**Bloom Taxonomy**
CO 1	Identifyandexplainvariousfrictionandwearmechanisms.	K2
CO 2	Selectproperlubricantsfordifferent applications.	K3
CO 3	Selectsuitablelubricationsmethodsindifferentbearings.	K3
CO 4	Studythesurfacescoatingtechniquesforreductionof wear.	K3
CO 5	Analyzetheimpactoffrictioninvariouskinematicpairs.	K4

Booksand References:

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) FundamentalsofMachineElements,B.J.Hamrock,B.O.Jacobson&S.R.Schmid,McGraw-HillInc., (1998).
6) FundamentalsofMechanicalComponentDesign,byK.S.Edwards&R.B.McKee,McGraw-HillInc., (1991).
7) Mechanical Engineering Design by J.E. Shigley and C R Mischke, Tata McGraw-Hill Publishing Company Limited, (2003).
8) Tribophysics,byN.P.SuhPrentice-Hall,(1986).
9) Friction,Wear,Lubrication:ATextbookinTribology,byKennethCLudema,LayoAjayi,CRCPress (2019).

Semester–VI:DepartmentalElective–III:Specialization–ThermalEngineering

SubjectCode: BTME604D	GasDynamicsandJet Propulsion	LTP:300	Credits:3

Courseobjectives

Tounderstandthebasicdifferencebetweenincompressibleandcompressibleflow. To understand the phenomenon of shock waves and its effect on flow.
Togainsomebasicknowledgeaboutjetpropulsionand RocketPropulsion.

UNIT -I:

Compressibleflow,definition,MachwavesandMachcone,stagnationstates,Mass,momentumandenergy equations of one-dimensional flow.

UNIT-II:

Isentropicflowthroughvariableareaducts,nozzlesanddiffusers,subsonicandsupersonicflowvariableareaducts, choked flow, Area-Mach number relations for isentropic flow.

UNIT -III:

Non-isentropicflowinconstantareaducts,RayleighandFanoflows,Normalshockrelations,obliqueshock relations, isentropic and shock tables.

UNIT-IV:

Theoryofjetpropulsion,thrustequation,thrustpowerandpropulsiveefficiency,Operatingprincipleandcycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT -V:

Typesofrocketengines,propellants&feedingsystems,ignitionandcombustion,theoryofrocketpropulsion, performance study, staging, terminal and characteristic velocity, space flights.

CourseOutcomes:Thestudentswillbeableto		Blooms Taxonomy
CO1	Understandtheconceptofcompressiblefluidflowandflowthrough variable areaducts.	K2
CO2	Understandthebasicprincipleandtypesofjetandrocketpropulsion.	K2

CO3	Applythebasiclawsfortheinvestigationofflowthroughducts.	K3
CO4	Applythebasic lawsforthethermodynamicsanalysisofjet androcket propulsion.	K3
CO5	Analyzethecompressibleflowthroughvariableareaducts.	K4

Booksand References:

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

Semester–VI:DepartmentalElective–III:Specialization–AutomobileEngineering

SubjectCode: BTME604E	AutomotiveElectricalandElectronics	LTP:300	Credits:3

Courseobjectives

Toequipstudentswiththeknowledgeandskillsrequiredtoworkintherapidlyevolvingfieldofautomotive industries.

AutomotiveElectronicsprovidestheknowledgeofbothElectricalEngineeringandAutomotiveEngineering.

[L8 Hours]

Unit1

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, Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests onBattery,Battery–ChargingTechniques.Maintenanceofbatteries.

Unit2 **[L8 Hours]**

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

Chargingsystemcomponents,GeneratorsandAlternators,types,constructionandCharacteristics,

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

Unit3 **[L8 Hours]**

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 **[L8 Hours]**

Automotive Electronics: Automotive networking, Bus system, Advantages of bus systems, requirements of buses, Buses in motor vehicle: CAN, FlexRay, LIN, Ethernet, IP, PSI5, MOST bus and optical fibers/wave guides, Architectures of electronic system.

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

Unit5 **[L8 Hours]**

Automotive Sensors and Actuators: Basic principle, Main requirements, Micromechanics, Position sensors, Speed and RPM sensors, Acceleration and vibration sensors, Pressure sensors, Flow meters, 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.

Thestudentswillbeableto		**Blooms Taxonomy**
CO-1	Understandthebasicconceptsofelectricalsystemsusedinautomobile.	K2
CO-2	Understandtheconstructionalfeaturesofchargestoragedevicesandmethods totestthesedevicesfortheirhealthy operation.	K2
CO-3	Understandtheprinciplesandcharacteristicsofchargingandstartingsystemof automobileandstudythevariousfaultsoccurringinsystem.	K2
CO-4	Understandtheignitionandauxiliarysystem-types&constructionalfeatures usedinautomobile.	K2
CO-5	Describetheprinciplesandarchitectureofelectronicssystemsandits componentspresentinanautomobilerelatedtodatatransfer,instrumentation, control,andsecurity systems.	K2
CO-6	Understandlatest trendsdevelopedinelectricalandelectronic systems of automobileandtheiradvantagesoverconventionaltechnologies.	K2

Books:

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

References:

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

OpenElective-I

RealTimeSystems

BTOE-605A

SubjectCode: BTME605A	RealTimeSystems	LTP:300	Credits:3

Courseobjectives

- Tostudythebasicoftasksandscheduling
- Tounderstandprogramminglanguagesanddatabases
- Toanalyzerealtimecommunication
- ToanalyzeevaluationtechniquesandreliabilitymodelsforHardwareRedundancy
- Tounderstandclocksynchronization

Unit	Topics	Lectures
I	**Introduction** Definition, Typical Real Time Applications: Digital Control, High LevelControls, Signal Processing etc., Release Times, Dead-lines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference ModelsforRealTimeSystems:ProcessorsandResources,TemporalParameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.	8
II	**RealTimeScheduling** Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First(LST)Algorithms,RateMonotonicAlgorithm,OfflineVersusOnline Scheduling,SchedulingAperiodicandSporadicjobsinPriorityDrivenandClock Driven Systems.	8
III	**ResourcesSharing** Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-CeilingProtocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access ControlinMultiple-ModuleResources,ControllingConcurrentAccessestoData Objects.	8
IV	**RealTimeCommunication** Basic Concepts in Real time Communication, Soft and Hard RT Communication systems, Model of Real Time Communication, Priority- Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium AccessControlProtocolsforBroadcastNetworks,InternetandResource ReservationProtocols.	8
V	**RealTimeOperatingSystemsand Databases** Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic ofTemporaldata,TemporalConsistency,Con-currencyControl,Overviewof CommercialRealTimedatabases.	8

CourseOutcomes:Attheendofthiscoursestudentswilldemonstratetheabilityto:

1. DescribeconceptsofReal-Timesystemsand modeling.
2. Recognizethecharacteristicsofareal-timesystemincontextwithrealtimescheduling.
3. Classifyvariousresourcesharingmechanismsandtheirrelatedprotocols.
4. Interpretthebasicsofrealtimecommunicationbytheknowledgeofrealtimemodelsandprotocols.
5. ApplythebasicsofRTOSininterpretationofrealtime systems.

Text Books:

1. RealTimeSystems–JaneW.S.Liu,PearsonEducation Publication.

ReferenceBooks:

1. RealTimeSystems–MallRajib,PearsonEducation
2. Real-TimeSystems:Scheduling,Analysis,andVerification–AlbertM.K.Cheng,Wiley.

EmbeddedSystem

BTOE-605B

SubjectCode: BTME605B	EmbeddedSystem	LTP:300	Credits:3

CourseObjectives: Aftercompletionofthecoursestudentwillbeableto:

1. Attaintheknowledgeofembeddedsystemanditsdevelopmentenvironment.
2. GaintheknowledgeofRTOSbasedembeddedsystemdesignanditsapplications.

Unit	Topic	Lectures
1	Introduction to Embedded Systems: IntroductiontoEmbeddedSystems – The buildprocessforembeddedsystems-StructuralunitsinEmbeddedprocessor, selection of processor & memory devices- DMA – Memory management methods-Timer and Counting devices, WatchdogTimer,RealTimeClock, In circuitemulator,TargetHardwareDebugging.EmbeddedNetworking: EmbeddedNetworking:Introduction,I/ODevicePorts&	8
2	Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers. Embedded Firmware Development Environment: Embedded Product Development	8
3	Life Cycle objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model. RTOS Based Embedded System Design: Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non preemptive scheduling, Task communication	8
4	shared memory, message passing-, Inter process Communication – synchronizationbetweenprocesses-semaphores,Mailbox,pipes,priority	8

	inversion,priority inheritance, comparison of Real time Operating systems: Vx Works, ЧC/OS-II, RT Linux. Embedded System Application Development:DesignissuesandtechniquesCase	
5	StudyofWashingMachine-AutomotiveApplication-SmartcardSystem Application.	**8**

CourseOutcomes: Aftercompletionofthecoursestudentwillbeableto:

1. Understandthebasicsofembeddedsystemanditsstructuralunits.
2. Analyzetheembeddedsystemspecificationanddevelopsoftwareprograms.
3. Evaluatetherequirementsoftheprogrammingembeddedsystems,relatedsoftwarearchitecture.
4. UnderstandtheRTOSbasedembeddedsystemdesign.

Understandalltheapplicationsoftheembeddedsystemanddesigningissues.

TextBooks:

1. WayneWolf,"ComputersasComponents:PrinciplesofEmbeddedComputerSystem Design" Elsevier, 2006.
2. MichaelJ.Pont,"EmbeddedC",PearsonEducation,2007.
3. SteveHeath,"EmbeddedSystemDesign",Elsevier,2005.
4. MuhammedAliMazidi,JaniceGillispieMazidiandRolinD.McKinlay,"The 8051.
5. MicrocontrollerandEmbeddedSystems",PearsonEducation,Secondedition,2007.

IntroductiontoMems

BTOE-605C

SubjectCode: BTME605C	**IntroductiontoMems**	**LTP:300**	**Credits:3**

CourseObjectives: Aftercompletionofthecoursestudentwillbeableto:

1. UnderstandtheBasicconceptofMEMS,MechanicsofBeamandDiaphragmStructures,Air Damping and Electrostatic Actuation.
2. KnowtheknowledgeofThermalEffectsandtheApplicationsofMEMSinRF.

Unit	Topic	Lectures
1	**IntroductiontoMEMS:** MEMSFabricationTechnologies,MaterialsandSubstratesforMEMS, ProcessesforMicromachining,Characteristics, Sensors/Transducers, PiezoresistanceEffect,Piezoelectricity,PiezoresistiveSensor.	**8**
2	**MechanicsofBeamandDiaphragmStructures:** Stress and Strain, Hooke's Law. Stress and Strain of Beam Structures: Stress, Strain in a Bent Beam, Bending Moment and the Moment of Inertia, DisplacementofBeamStructuresUnderWeight,BendingofCantilever BeamUnderWeight.	**8**

3	**AirDamping:** Drag Effect of a Fluid: Viscosity of a Fluid, Viscous Flow of a Fluid, Drag Force Drag Effect of a Fluid: Viscosity of a Fluid, Viscous Flow of a Fluid, Drag Force Damping, The Effects of Air Damping on Micro-Dynamics. Squeeze-film Air Damping: Reynolds' Equations for Squeeze-film Air Damping, Damping of Perforated Thick Plates. Slide-film Air Damping: Basic Equations for Slide-film Air Damping, Couette-flow Model, Stokes-flow Model.	**8**
4	**ElectrostaticActuation:** Electrostatic Forces, Normal Force, Tangential Force, Fringe Effects, Electrostatic Driving of Mechanical Actuators: Parallel-plate Actuator, Capacitivesensors.StepandAlternativeVoltageDriving:StepVoltage Driving,NegativeSpringEffectandVibrationFrequency.	**8**
5	**ThermalEffects:** Temperaturecoefficientofresistance,Thermo-electricity,Thermocouples, Thermal and temperature sensors. **ApplicationsofMEMSinRF** MEMSResonatorDesignConsiderations,One-PortMicromechanical ResonatorModelingVertical DisplacementTwo-PortMicroresonator Modeling, Micromechanical Resonator Limitations.	**8**

CourseOutcomes: Aftercompletionofthecoursestudentwillbeableto:

1. UnderstandtheBasicconceptofMEMSFabricationTechnologies,PiezoresistanceEffect, Piezoelectricity, Piezoresistive Sensor.
2. ExplainMechanicsofBeamandDiaphragmStructures.
3. UnderstandtheBasicconceptofAirDampingandBasicEquationsforSlide-filmAirDamping, Couette-flow Model, Stokes-flow Model.
4. KnowtheconceptofElectrostaticActuation.
5. UnderstandtheapplicationsofMEMSinRF

Text&ReferenceBooks:

1. G.K.Ananthasuresh,K.J.Vinoy,S.Gopalakrishnan,K.N.BhatandV.K.Atre,"Microandsmart systems", Wiley India, 2010.
2. S.M.Sze,"SemiconductorSensors",JohnWiley&SonsInc.,WileyIntersciencePub.
3. M.J.Usher,"SensorsandTransducers",McMillianHampshire.
4. RSMuller,Howe,SenturiaandSmith,"Microsensors",IEEEPress.

ObjectOrientedProgramming

BTOE-605D

SubjectCode: BTME605D	**ObjectOrientedProgramming**	**LTP:300**	**Credits:3**

CourseObjectives:

1. Understandobject-orientedprogrammingfeaturesbyJAVA,
2. Applythesefeaturestoprogramdesignandimplementation,
3. Understandobject-orientedconceptsandhowtheyaresupportedbyJAVA,
4. Understandimplementationissuesrelatedtoobject-orientedtechniques,
5. Buildgoodqualitysoftwareusingobject-orientedprogrammingtechnique

UNIT-I

Introduction & Fundamentals of JAVA, Background of JAVA, About Java Technology, Java's architecture, Reading console inputs, Arrays,Constructors, Finalize method, final, this method and reference, static members.

UNIT-II

Concrete class, Abstract class, Interface, Inner classes. Aggregation, Composition and Inheritance, super method and reference. Method overloading and overriding. Singleton classes. Package concepts. Exception Handling: Inbuilt, User defined, Checked and Unchecked.

UNIT-III

String class. Wrapper classes (Integer, Boolean, Character, etc.). Multi-threading: Thread concept, Thread class, Runnable interface, Creating customized threads, Thread synchronization, Thread class methods. Java I/O: Use of Input Stream, Output Stream, Reader and Writer classes for reading from and writing data into disk files.

UNIT-IV

AWT & SWING: Frame, Panel, Dialog, CheckBox, Choice, List, JComboBox, JFrame, JPanel, JRadioButton, JScrollPane, JTabbedPane, Using Listeners: ActionListener, ContainerListener, FocusListener, ItemListener, KeyListener, MouseListener, TextListener, WindowListener.Applets. JDBC: Type1 to Type4 drivers. Java Networking: Server Socket, Socket, RMI.

UNIT-V

Collections Frameworks: HashSet, TreeSet, ArrayList, LinkedList, Vector, HashMap, TreeMap, Hashtable classes.Generics in Java: Creating instances ofgeneric classes,generic types, Declaring (and invoking) methods that take generic types. Creating and running executable JAR (Java ARchives).

CourseOutcomes[Thestudentsshouldbeableto]:

1. ApplyJavaindevelopingObjectOrientedcode.
2. ApplytheknowledgeofMulti-threadingandStreamsindevelopingJavaapplications.
3. DesignandimplementapplicationsusingGUIandNetworkingin Java.
4. ApplytheknowledgeofCollectionsandGenericsforbuildingJava applications.
5. DesignanddevelopJavabasedapplicationsforsolutionstorealworldproblems.

TextBooks:

1. HerbertSchildt:"JavaABeginner'sGuide,7thedition",OraclePress.
2. MauriceNaftalin,PhilipWadler,"JavasGenericsandCollections",O'ReillyMedia, Inc.
3. BenjaminJEvans,DavidFlanagan.,"JavainaNutshell",O'ReillyMedia,Inc.

NumericalTechniques

BTOE-605E

SubjectCode: BTME605E	NumericalTechniques	LTP:300	Credits:3

CourseObjective: Studentsundergoingthiscourseareexpectedto-

1. Understandaboutthebasicsofnumericaltechniquesanditsapplicationsto EngineeringProblems.

Unit	Topic	Lectures
1	Ordinary Differential Equations, Separable equations, Equations made separable by change of variables, Homogeneous Equations, Equations with first order and first degree with linear coefficients, Exact equations, Linear equation of first order, Bernoulli's equation, Other degree, Clairaut's equation, Singular solutions, Equations with missing terms, General properties of Linear equations, Linear equations with constant coefficients, Determination of the complementary function, exponential functions, Determinationoftheparticularintegral,theEulerequation,Simultaneous LinearDifferentialequations.	8
2	Powerseriesmethod,theoryofthepowerseriesmethod,Legendre's equation, Legendre's Polynomials, Frobenius Method.	8
3	Bessel'sequation, Bessel FunctionsJv(x), Bessel FunctionsJv(x) for any v≥0. GammaFunction,SolutionJ-v(x)oftheBesselEquation,BackbonesofBessel's Theory, Jv(x) with v= ±1/2, ±3/2, ±5/2.	8
4	Definition of matrix, Some special definitions and operations involving matrices, Determinants, Theorems on determinants, Inverse of a matrix, Orthogonal and unitary matrix. Orthogonal vectors, System of linear equations,Systemsonnequationswithnunknowns,Cramer'sRule,Eigen valuesandeigen vectors.	8
5	Analysis of Stage wise Processes by the Calculus of Finite Differences, Countercurrent Liquid- Liquid Extraction, Solution of Difference Equations, Stirred-TankReactorSystemDistillationinaPlateColumn,Unsteady-state Operation, Starting a Stirred-tank Reactor, Rate at which a Plate Absorber Approaches Steady State.	8

CourseOutcomes: Aftercompletionofthecoursestudentwillbeableto-

1. UnderstandaboutthebasicsofOrdinaryDifferentialEquations,Separableequations,Equations made separable by change of variables.
2. RetrievetheinformationcontentofPowerseriesmethod.
3. CO3:ApplyproblemspecificBessel'sequation,BesselFunctionstoengineeringapplications.
4. Understandaboutthebasicsofmatrix,Eigenvaluesandeigenvectors.
5. AnalysisofStagewiseProcessesbytheCalculusofFiniteDifferences,CountercurrentLiquid- Liquid Extraction.

Text&Referencebooks:

1. Mickley,ReidandSherwood,"AppliedMathematicsinChemicalEngineering",TataMcGrawHill, New Delhi (1981).
2. E.Kreyszig,"AdvancedEngineeringMathematics",8thedition,JohnWileyandSons(1999).
3. M.R.Spiegel,"AdvancedMathematicsforEngineersandScientists",SchaumOutlineSeries, McGraw Hill, (1971).
4. ChandrikaPrasad,ReenaGarg,"AdvancedEngineeringMathematics",KhannaPublishinghouse

GIS&RemoteSensing

BTOE-605F

SubjectCode: BTME605F	GIS&RemoteSensing	LTP:300	Credits:3

CourseObjective: Studentsundergoingthiscoursareexpectedto-

1. Understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

Unit	Topic	Lectures
1	Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land andwater resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows; principalapplicationsofdifferentwavelengthregions;typicalspectral reflectancecurveforvegetation,soilandwater,spectralsignatures.	8
2	Differenttypesofsensorsandplatforms;contrastratioandpossiblecausesof low contrast; aerial photography; types of aerial photographs, scale of aerial photographs,planningaerialphotography-endlapandsidelap;stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation-interpretation elements;	8
3	Photogrammetry- measurements on a single vertical aerial photograph, measurementsonastereo-pair-verticalmeasurementsbytheparallaxmethod; ground control for aerial photography; satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification,importantconsiderationintheidentificationoftrainingareas, vegetationindices.	8
4	Microwaveremotesensing.GISandbasiccomponents,differentsourcesof spatialdata,basicspatialentities,majorcomponentsofspatialdata,Basic classesofmapprojectionsandtheirproperties..	8
5	Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, ApplicationofremotesensingandGISforthemanagementoflandandwater resources.	8

CourseOutcomes:*Aftercompletionofthecoursestudentwillbeableto-*

1. UnderstandabouttheprinciplesofRemoteSensinganditsadvantagesandlimitations.
2. Retrievetheinformationcontentofremotelysensed data.
3. Applyproblemspecificremotesensingdataforengineeringapplications.
4. Analyzespatialandattributedataforsolvingspatialproblems.
5. CreateGISandcartographicoutputsfor presentation

Text&ReferenceBooks:

1. ReddyAnji,M.2006.TextbookofRemoteSensingandGeographicalInformationSystems.BS Publications, Hyderabad.
2. Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
3. GeorgeJoseph.2005.FundamentalsofRemoteSensing.2ndEdition.UniversitiesPress(India) Private Limited, Hyderabad.
4. Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. PearsonEducation Limited, UK.
5. Lillesand,T.,R.W.KieferandJ.Chipman.2015.RemoteSensingandImageInterpretation.7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.
6. Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland PressInc., Illinois, USA.

UnderstandingtheHumanBeingComprehensively–HumanAspirationsanditsFulfillment
BTOE-605G

SubjectCode: BTME605G	**Understanding the Human Being Comprehensively–HumanAspirationsand its Fulfillment**	**LTP:300**	**Credits:3**

CourseObjectives:

1. Tohelpthestudentshavingtheclarityabouthumanaspirations,goal,activitiesandpurposeoflife.
2. Tofacilitatethecompetencetounderstandtheharmonyinnature/existenceandparticipationof human being in the nature/existence.
3. Tohelpthestudentstodeveloptheunderstandingofhumantraditionanditsvariouscomponents.

Unit	Topic	Lectures
1	**Introduction:** The basic human aspirations and their fulfillment through Right understandingandResolution;All-encompassingResolutionforaHuman Being,itsdetailsandsolutionofproblemsinthelightofResolution.	**8**
2	**UnderstandingHumanbeingandits expansion:** Thedomainofrightunderstandingstartsfromunderstandingthehuman being(theknower,theexperienceandthedoer);andextendsupto understandingnature/existence –ininterconnectedness andco-existence; and finally understanding the role of human being in ence (human conduct).	**8**
3	**Activitiesofthe Self:** Understanding the human being comprehensively is the first step and the core themeofthiscourse;humanbeingasco-existenceoftheselfandthebody;the activities and potentialities of the self; Reasons for harmony/contradiction in theself.	**8**
4	**UnderstandingCo-existencewithotherorders:** The need and the process of inner evolution (through self-exploration, selfawareness and self-evaluation)- particularly awakening to activities of the Self:Realization,UnderstandingandContemplationintheSelf(Realizationof Co-Existence, Understanding of Harmony in Nature and Contemplation of ParticipationofHumaninthisharmony/orderleadingtocomprehensive knowledgeabouttheexistence).	**8**
5	**Expansionofharmonyfromselftoentireexistence:** Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for HumanBeing with All-encompassing Resolution covering all four dimensions of humanendeavourviz.,realization,thought,behaviorandwork(participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.	**8**

CourseOutcomes(COs)	Description
CO1	Understandbasichumanaspirationsandtheirfulfillmentthrough Right

	understandingandResolution.
CO2	UnderstandHumanbeinganditsexpansion.
CO3	Understandhumanbeingasco-existenceoftheselfandthebody.
CO4	UnderstandingofHarmonyinNatureandContemplationofParticipation of Humaninthisharmony.
CO5	Understandingrealization,thought,behaviorandwork.

ReferenceBooks:

1. AFoundationCourseinHumanValuesandProfessionEthics(TextBookandTeachers'Manual), R.R.Gaur,R.Sangal,G.P.Bagaria(2010),ExcelBooks,NewDelhi[ISBN978-8-174-46781-2]
2. AvartansheelArthshastra,A.Nagraj,DivyaPathSansthan,Amarkantak,India
3. EconomyofPermanence–(aquestforsocialorderbasedonnon-violence),J.C.Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
4. EnergyandEquity,IvanIllich(1974),TheTrinityPress,Worcester&HarperCollins,USA
5. IshandiNauUpnishad,Shankaracharya,Geetapress,Gorakhpur,
6. ManavVyavaharDarshan,A.Nagraj,DivyaPathSansthan,Amarkantak, India
7. ManaviyaSanvidhan,A.Nagraj,DivyaPathSansthan,Amarkantak,India

B-Tech(ME)7thSemester

CAD/CAM

(BTME701)

SubjectCode: BTME701	CAD/CAM	LTP:310	Credits:4

CourseObjective

The **course** is aimed at giving exposure to and enhancing the knowledge and skills of fresh graduate engineers and engineers involved in the operation use of CNC machines, **CAD**/**CAM**packages and forthose who want to provide training to others in this area.

UNIT-I:

PrinciplesofComputerGraphics:

Point plotting, drawing of lines, Bresenham's circle algorithm. Transformation in Graphics: Co-ordinate system used in Graphics and windowing, view port, views. 2D transformations – rotation, scaling, translation, mirror, reflection, shear – homogeneous transformations – concatenation. 3D Transformation – Perspective Projection – Technique (Description of techniques only). Geometric Modelling: Classification ofGeometricModelling– Wireframe, Surfaceand SolidModelling, applications –representationofcurves and surfaces – Parametric form. Design of curved shapes- Cubic spline – Bezier curve – B-spline – Design ofSurfaces-featuresofSurfaceModellingPackage–SolidPrimitives,CSG.B-repanddescriptionofother modelling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, BooleanOperations(join,cut,intersection),Creating3Dobjectsfrom2Dprofiles(extrusion,revolvingetc).

UNIT-II:

Graphics standard&Datastorage:Standards for computer graphics GKS, PHIGS. Data exchange standards – IGES, STEP – Manipulation of the model - Model storage. Finite Element Modelling: Introduction, Mesh Generation –mesh requirements.Semi-Automatic Methods-Node-basedapproach,Region based approach, Solid-modelling-based methods. Fully Automatic Methods- Element-based approach, Application, Mesh Refinements using Isoperimetric Finite Elements, Meshing in high gradient areas, Transition Regions. Sub modeling Concept. An overview of modelling software's like PRO-E, CATIA, IDEAS, SOLID EDGE etc.

UNIT-III:

CAM: Scope and applications –NC in CAM –Principal types of CNC machine tools andtheir construction features– tooling for CNC– ISOdesignationfortooling– CNCoperatingsystem –FANUC, SINUMERIK – LINUMERIK. Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system. Material handling in CAM environment: Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

UNIT-IV:

Robotics: Classification and specification – drive and controls – sensors - end effectors - grippers- tool handling and work handling – machine vision – robot programming concepts – case studies in assembly. Quality Function Deployment: Process Planning – CAPP – Variant and Generative systems- Concurrent EngineeringandDesignforManufacturing.AdvancedmanufacturingPlanningComputerAidedProduction Planning and Control – Aggregate production planning and master production schedule – MRP – MRP II – ERP - Capacity planning.

UNIT-V:

Rapidprototyping: Needfor rapidprototyping, Basicprinciples andadvantages of RP, General features and classificationsofdifferentRPtechniqueswithexamples.IntroductiontothreerepresentativeRPtechniques: Fusion Deposition Modelling, Laminated Object Manufacturing and Stereo-lithography. Flexible manufacturing cells: Systems – characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects.

CourseOutcomes(COs)	Description
CO1	Thestudentwillbeabletodescribebasicgeometric modelling.
CO2	Thestudentwillbeabletousefiniteelementmodelingtechnique for solvingproblem.
CO3	Thestudentwillbeabletounderstandtheworkingand programming for CNC.
CO4	Thestudentwillbeabletounderstandhowtherobotfunction.
CO5	Studentslearntheconceptsofrapidtool processing.

Booksand References:

1. Chris Mcmahon and - CAD/CAM – Principle Practice and Manufacturing Management, Jimmie Browne Addision Wesley England, Second Edition,2000.
2. Dr.Sadhu Singh - Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition,2000.
3. P.Radhakrishnan,-CAD/CAM/CIM,NewAgeInternational(P)Ltd.,New Delhi.S.Subramanayanand V.Raju.
4. GrooverM.P.and-CAD/CAM; ComputerAidedDesignandManufacturing,PrenticeHallZimmersEW. International, New Delhi, 1992.
5. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd.,Company Ltd.,New Delhi, 1992.
6. Mikell P.Groover - Automation , Production Systems and Computer IntegratedManufacturing, Secondedition, Prentice Hall of India, 2002.
7. S.KantVajpayee-PrinciplesofComputerIntegratedManufacturing,PrenticeHallofIndia,1999.
8. DavidBedworth-ComputerIntegratedDesignandManufacturing,TMH,1998.

CAD/CAM-Lab

(BTME705P)

SubjectCode: BTME705P	**CAD/CAM-Lab**	**LTP:002**	**Credits:2**

CourseObjective

It is tointroduce geometricmodelingtechniques, datastructure **design**andalgorithms for solidmodeling. It also covers the machining theory, automated CNC machining, and process control.List of Experiments: (Total EIGHT Experiments are to carried out. FOUR Experiments each from

CADand CAM.)

A. CADExperiments:

1. LineDrawingorCircleDrawingexperiment:Writingandvalidationofcomputerprogram.
2. GeometricTransformationalgorithmexperimentfortranslation/rotation/scaling:Writingand validation of computer program.
3. Designofmachinecomponentorothersystemexperiment:Writingandvalidationofcomputer program.
4. Understandinganduseofany3-DModellingSoftware commands.
5. Pro/E/Ideaetc.Experiment:Solidmodellingofamachinecomponent.
6. WritingasmallprogramforFEMfor2springsystemandvalidationofprogramorusingaFEM Package.
7. Rootfindingsorcurvefittingexperiment:Writingandvalidationofcomputerprogram.
8. Numericaldifferentiationornumericalintegrationexperiment:Writingandvalidationofcomputer program.

B. CAMExperiments:

1. TostudythecharacteristicfeaturesofCNCmachine.
2. Part Programming (in word address format) experiment for turning operation (including operationssuch as grooving and threading) and running on CNC machine.
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. PartProgramming(in wordaddressformatorATP)experimentformilling operation (contouring) and running on CNC machine.
5. ExperimentonRobotandprograms.
6. ExperimentonTransferline/Materialhandling.
7. Experimentondifferencebetweenordinaryand NCmachine,studyorretrofitting.
8. Experimentonstudyofsystemdevicessuchasmotorsandfeedback devices.
9. ExperimentonMechatronicsandcontrols.

CourseOutcome

1. SketchsimplefigureswithtitleblockusingAutoCADsoftware commands.

2. Sketchcurveslikeparabola,spiralandinvoluteofsquare&circleanddrawtheorthographic projection of simple solids.

3. Prepareorthographicprojectionofsimplemachinepartsanddrawaplanofresidentialbuilding.

4. Sketchsimplesteeltrussandsectionalviewsofsimple solids.

5. Prepare2Dmultiviewdrawingfrom3Dmodel.

DepartmentalElective-IV

Power Plant Engineering

(BTME702A)

SubjectCode: BTME702A	**PowerPlantEngineering**	**LTP:300**	**Credits:3**

CourseObjective

To introduce students to different aspects of **power plant engineering**. To familiarize the students to the working of**power plants**based on different fuels. To expose the students to the principles of safety and environmental issues.

UNIT-I:

Introduction:

Power and energy, sources of energy, review of thermodynamic cycles related to power plants,fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements andinvestor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

UNIT-II:

Steampowerplant:

General layout of steam power plant, Power plant boilers including critical and super criticalboilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coalhandling system, pulverisers and coal burners, combustion system, draft, ash handling system,Dust collection system, Feed water treatment and condenser and cooling towers and coolingponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating andgland leakage. Operation and maintenance of steam power plant, heat balance and efficiency,Site selection of a steam power plant.

UNIT-III:

Dieselpowerplant:

General layout, Components of Diesel power plant, Performance of diesel power plant, fuelsystem, lubrication system, air intake and admission system, supercharging system, exhaustsystem, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant,Comparative study of diesel power plant with steam power plant. Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels,cogeneration, auxiliary systems such as fuel, controls and lubrication, operation andmaintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifierbased Combined Cycle (IGCC) systems.

UNIT-IV:

Nuclearpowerplant:

Layout and subsystems of nuclear power plants, BoilingWater Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, PressurizedHeavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metalcooled reactors, safety measures for nuclear power plants. Hydroelectric and Non-Conventional Power Plant: Hydroelectric power plants, classification, typical layout and components, principles of wind,tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

UNIT-V:

Electricalsystem:

Generators and generator cooling, transformers and their cooling, bus bar, etc. Energy Saving and Control: Energy, economic and environmental issues, power tariffs, load distribution parameters, loadcurve, capital and operating cost of different power plants, pollution control technologiesincluding waste disposal options for coal and nuclear plants.

CourseOutcomes(COs)	Description
CO1	Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
CO2	Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts.
CO3	Combine concepts of previously learnt courses to define the working principle ofdiesel power plant, its layout, safety principles and compare it with plants of other types.
CO4	Describetheworkingprincipleandbasiccomponentsofthenuclear power plantand the economic and safety principles involved with it.
CO5	Discuss the working principle and basic components of the hydro electric plants and the economic principles and safety precautions involved with it.

Booksand References:

1. PowerPlantEngineering,byF.T.Morse,AffiliatedEast-WestPressPvt. Ltd.
2. PowerPlantEngineeringbyHedge,PearsonIndia.
3. PowerPlantTechnology,byWakil,McGraw Hill.
4. PowerPlantEngineeringbyP.K.Nag,TataMcGrawHill.
5. Steam&GasTurbines&PowerPlantEngineeringbyR.Yadav,CentralPub.House.
6. PowerPlantEngineeringbyGupta,PHI India.
7. ElWakilM.M.,PowerPlantTechnology,TataMcGrawHill,2010.
8. PowerPlantEngineering.MaheshVerma,MetropolitanBookCompanyPvt. Ltd.

AdditiveManufacturing

(BTME702B)

SubjectCode: BTME702B	**AdditiveManufacturing**	**LTP:300**	**Credits:3**

CourseObjective

To introduce students the basics of **additive manufacturing**/rapid prototyping and its applications in various fields, reverse engineering techniques. To familiarize students with different processes in rapid prototyping systems.

UNIT-I:
Introduction:
HistoryandAdvantagesofAdditiveManufacturing,DistinctionBetweenAdditiveManufacturingandCNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines, Direct and Indirect Processes: Prototyping, Manufacturing and Tooling. Layer Manufacturing Processes: Polymerization,SinteringandMelting,Extrusion,Powder-BinderBonding,LayerLaminateManufacturing, Other Processes; Aerosol printing and Bio plotter.

UNIT-II:
DevelopmentofAdditiveManufacturingTechnology:
Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems. Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT-III:
AdditiveManufacturingProcesses:
Vat Photo polymerization, Materials, Reaction Rates, Photo polymerization Process Modelling, Scan Patterns, Powder Bed Fusion Processes; Material, Powder Fusion Mechanism, Process Parameters and Modelling, powder Handling, Extrusion Based System; Basic principles, plotting and Path Control, Bio extrusion, Other Systems, Material Jetting; Materials, Material Processing Fundamentals, Material Jetting Machines, Binder Jetting; Materials, Process Variations, BJ Machines, Sheet lamination Processes; Materials, Ultrasonic Additive Manufacturing, Directed Energy Deposition Processes; General DEDProcessDescription,MaterialDelivery,DEDsystems,ProcessParameters,Processing-Structure-Properties Relationships, Direct Write Technologies; Ink-Based DW, laser Transfer DW, Thermal Spray DW, Beam Deposition DW, Liquid Phase Direct Deposition, Hybrid Technologies.

UNIT-IV:
Design&SoftwareIssues:
Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AMbased New Strategies, Material Design and Quality Aspects for Additive Manufacturing;Material for AM, Engineering Design Rules for AM. Software Issue for Additive Manufacturing; Introduction, Preparation of CAD Models: TheSTL file, Problem with STL file, STL file Manipulation, Beyond the STL file, AdditionalSoftware to Assist AM.

UNIT-V:

MaterialDesign&QualityAspects:
Machines for Additive Manufacturing, Printers, Secondary Rapid Prototyping processes, Intellectual Property, Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing,BusinessOpportunitiesApplications:Aerospace,Automotive,Manufacturing,Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

CourseOutcome

- Describeadditivemanufacturingandexplainitsadvantagesanddisadvantages
- Explaintheprocessesusedinadditivemanufacturingforarangeofmaterialsandapplications
- Understandtheroleofadditivemanufacturinginthedesignprocessandtheimplicationsfordesign
- Describetheeffectsofsurfacefinishandmicrostructuralpropertiesonbehaviourforcomponents produced using additive manufacturing
- Displayanawarenessofresidualstressesthatmayoccurduringadditivemanufacturingandtheir effects.

Booksand References:

1. AdditiveManufacturingTechnologies:RapidPrototypingtoDirectDigitalManufacturing,by-Ian Gibson, D Savid W. Rosen, Brent Stucker, Springer.
2. AdditiveManufacturing,by-AmitBandyopadhyay,SusmitaBose,CRCPress.
3. RapidPrototyping:PrinciplesandApplications,by-CheeKaiChua,KahFaiLeong,ChuSingLim.

4. AdditiveManufacturingTechnologies:3DPrinting,RapidPrototyping,andDirectDigital Manufacturingby Ian Gibson and David Rosen.
5. AdditiveManufacturingofMetals:FromFundamentalTechnologytoRocketNozzles,MedicalImplants, and Custom Jewelry (Springer Series in Materials Science) by John O Milewski.
6. AdditiveManufacturing:AdvancedManufacturingTechnologyin3dPrintDepositby SabrieSoloman.
7. Advances in 3D Printing and Additive Manufacturing Technologies by David Ian Wimpenny and Pulak M Pandey.
8. UnderstandingAdditiveManufacturing,by-AndreasGebhardt,Hanser.

VehicleBodyEngineeringandSafety

(BTME702C)

SubjectCode: BTME702C	**VehicleBodyEngineeringandSafety**	**LTP:300**	**Credits:3**

CourseObjective

- Classifythevehiclesanddefinebasic terms.
- Selectappropriatebody material.
- Calculatevariousaerodynamicforcesandmomentsactingonvehicle.
- Calculateloaddistributioninvehiclebody.
- Explaintheergonomics,stabilitythevehicle.
- Identifythevarioussafetyaspectsinagivenvehicle.
- Identifyvarioussourcesofnoiseandmethodsofnoise separation.

UNIT-I:

Introduction:

Designofthebodyforsafety,energyequation,enginelocation,decelerationofvehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

UNIT-II:

Safetyconcepts:

Activesafety:drivingsafety,conditionalsafety,perceptibilitysafety,operatingsafety, passive safetyexteriorsafety,interiorsafety,deformationbehaviourofvehiclebody,speedandacceleration characteristics of passenger compartment on impact.

UNIT-III:

Safetyequipment's:

Seatbelt,regulations,automaticseatbelttightenersystem,collapsiblesteeringcolumn,tiltablesteering wheel, air bags, electronic system for activating air bags, bumper design for safety.

UNIT-IV:

Collisionwarningand avoidance:

Collisionwarningsystem, causes of rearend collision, frontalobject detection,rear vehicle objectdetection system, object detection system with braking system interactions.

UNIT-V:

Comfortandconveniencesystem:

Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.

CourseOutcome

- Classifythevehiclesanddefinebasic terms.
- Selectappropriatebody material.
- Calculatevariousaerodynamicforcesandmomentsactingonvehicle.
- Calculateloaddistributioninvehiclebody.
- Explaintheergonomics,stabilitythevehicle.

- Identifythevarioussafetyaspectsinagivenvehicle.
- Identifyvarioussourcesofnoiseandmethodsofnoise separation

ReferenceBooks:

1. Bosch,“AutomotiveHandbook”,8thEdition,SAEpublication,2011.
2. Powloski.J.,“VehicleBodyEngineering”,Businessbookslimited,London,1969.
3. Ronald.K.Jurgen,“AutomotiveElectronicsHandbook”,SecondEdition,McGraw-HillInc., 1999.

Departmental Elective-V

AutomationandRobotics

(BTME703A)

SubjectCode: BTME703A	**AutomationandRobotics**	**LTP:300**	**Credits:3**

CourseObjective

Students will understand the techniques and applications of Automation and Robotics Programming in an industrial environment. They will learn to design and implement robotic systems and apply what they learned to a career in the Automation and Robotics field.

UNIT-I:

Automation:
Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.

UNIT-II:
ManufacturingAutomation:
Classificationandtypeofautomatictransfermachines;Automationinparthandlingandfeeding,Analysisof automated flow lines, design of single model, multimodel and mixed modelproduction lines. Programmable Manufacturing Automation CNC machine tools, Machiningcentres, Programmable robots, Robot time estimation in manufacturing operations.

UNIT-III:
Robotics:
Definition, ClassificationofRobots -Geometric classification and Control classification,Laws ofRobotics, Robot Components, Coordinate Systems, Power Source.Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulatorkinematics, position representation, forward and reverse transformations, homogeneoustransformations in robot kinematics, D-H notations, kinematics equations, introduction to robotarm dynamics.

UNIT-IV:
RobotDrivesandPowerTransmissionSystems:
Robot drive mechanisms: Hydraulic / Electric / Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion,Rotary-to-Linearmotionconversion,RackandPiniondrives,Leadscrews,BallBearings.Robot end Effectors: Classification of End effectors – active and passive grippers, Tools as end effectors, Drivesystem for grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis andgripper design.

UNIT-V:
RobotSimulation:

Methods of robot programming, Simulation concept, Off-line programming, advantages of off line programming. Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitationof usage of robots inprocessingoperation. Robot cell designand control, Robot cell layouts-Multiple robots & Machine interference.

CourseOutcome

- Describeindetailhowindustrialrobotsystemsareused,structuredandoperate,
- Describeindetailthestructureandoperationofrobotictooling,includingactuators,mechanicsandsensors,
- Describeotherpartsofautomatedmanufacturingsystems,includingprocesscontrol,componentflows, machine safety and personal safety,
- Describecomputer-aidedproductiontoolsanddatacommunicationwithinanindustrialroboticsnetwork,
- Identify fundamental issues within sustainable industrial development from an automation perspective and be able to exemplify the consequences of these,
- Implement and present a basic automation task with an industrial robot, including pilot study, online andoffline programming and evaluation of the results, based on a given specification.

Booksand References:

1. AnIntroductiontoRobotTechnology,byCoifetChirroza,KoganPage.
2. RoboticsforEngineers,byY.Koren,McGraw Hill.
3. Robotic:Control,Sensing,VisionandIntelligence,byFu,McGrawHill.
4. IntroductiontoIndustrialRobotics,byNagrajan,PearsonIndia.
5. Robotics,byJ.J.Craig,Addison-Wesley.
6. IndustrialRobots,byGroover,McGrawHill.
7. RoboticEngineering-AnIntegratedApproach:RichardD.KlafterThomasA.
8. Robots&ManufacturingAutomation,byAsfahl,Wiley.

ModellingandSimulation

(BTME703B)

SubjectCode: BTME703B	**ModellingandSimulation**	**LTP:300**	**Credits:3**

CourseObjective

Students will learn different types of **simulation**techniques. software. **Course**Outline:**Modeling and Simulation**has become an essential tool for engineers for optimum design and the**course aims**to impartan overview of the **modeling and simulation** approaches with emphasis on applications using MATLAB.

UNIT-I:
Bioinformatics objectives and overviews, Interdisciplinary nature of Bioinformatics, Data integration, Data analysis, Major Bioinformatics databases and tools. Metadata: Summary & reference systems, finding new type of data online. Molecular Biology and Bioinformatics: Systems approach in biology, Central dogma of molecular biology, problems in molecular approach and the bioinformatics approach, overview of the bioinformatics applications.

UNIT-II:
Basic chemistry of nucleic acids, Structure of DNA, Structure of RNA, DNA Replication, Transcription-Translation, Genes- the functional elements in DNA, Analyzing DNA, DNA sequencing. Proteins: Amino acids,Proteinstructure,Secondary,TertiaryandQuaternarystructure,Proteinfoldingandfunction,Nucleic Acid-Protein interaction.

UNIT-III:
Perl Basics, Perl applications for bioinformatics- Bio Perl, Linux Operating System, mounting/unmounting files, tar, gzip / gunzip,telnet, ftp, developing applications on Linux OS,
Understanding andUsing Biological Databases, Overview of Java, CORBA, XML, Webdeployment concepts.

UNIT-IV:
Genome, Genomic sequencing, expressed sequence tags, gene expression, transcription factor binding sites and single nucleotidepolymorphism. Computational representationsof molecular biological data storage techniques:databases(flat,relationalandobjectoriented),andcontrolledvocabularies,generaldataretrieval techniques: indices, Booleansearch, fuzzy search and neighbouring, application to biological datawarehouses.

UNIT-V:
Macromolecular structures, chemical compounds, generic variability and its connection to clinical data. Representationofpatternsandrelationships:sequencealignmentalgorithms,regularexpressions,hierarchies and graphical models, Phylogenetics. BLAST.

CourseOutcome
CO1.Grasping **modeling**conceptsusingmeanvalueanalysiswithsomeinformationtechnologyapplications.
CO2.Graspinghowtobuildappropriate **simulationmodels** togetherwiththeirparameterizationand the analysis of simulator output data.

CO3:Discussthefundamentallawsusefulindevelopingamodel. CO4:
Develop the mathematical model of a given system
CO5:Developthemathematicalmodelforcomplexchemicalengineeringsystemsfrombasic principles

Booksand References:

1. DEKrane&MLRaymer,"FundamentalconceptsofBioinformatics",Perason Education.
2. Rastogi, Mendiratta, Rastogi, "Bioinformatics Methods & applications, Genomics, Proteomics & Drug Discovery" PHI, New Delhi.
3. ShubhaGopalet.al."Bioinformatics:withfundamentalsofgenomicsandproteomics",McGrawHill.
4. O'Reilly,"DevelopingBioinformaticscomputerskills",CBS.
5. SimulationModelDesign&executionbyFishwich,PrenticeHall, 1995.
6. DiscreteeventsystemsimulationbyBanks,Carson,NelsonandNicol.
7. AverillM.Law,W.DavidKelton,"SimulationModellingand Analysis",TMH.
8. Forsdyke,"EvolutionaryBioinformatics",Springer.

ComputationalFluidDynamics

(BTME703C)

SubjectCode: BTME703C	**ComputationalFluidDynamics**	**LTP:300**	**Credits:3**

CourseObjective:
To introduce the student to widely used techniques in the numerical solution of **fluid**equations, issues that arise in the solution of such equations, and modern trends in **CFD**.
Emphasiswillbeon'**learning**bydoing',asstudentswillworkonprogrammingprojectsforassignments.

UNIT-I:
GoverningEquationsandBoundaryConditions:
Basics of computational fluid dynamics. Governing equations of fluid dynamics. Continuity, Momentum and Energy equations. Chemical species transport. Physical boundary conditions, Time averaged equations forTurbulentFlow.Turbulent–KineticEnergyEquationsMathematicalbehaviourofPDEsonCFD.Elliptic, Parabolic and Hyperbolic equations.

UNIT-II:
FiniteDifferenceMethod:
Derivation of finite difference equations. Simple Methods. General Methods for first and second order accuracy, solution methods for finite difference equations. Elliptic equations. Iterative solution Methods. Parabolic equations. Explicit and Implicit schemes. Example problems onelliptic and parabolic equations.

UNIT-III:
FiniteVolumeMethod(FVM)forDiffusion:
Finite volume formulation for steady state One, Two- and Three-dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank. Nicolson and fullyimplicitschemes.

UNIT-IV:
FiniteVolumeMethodforConvectionDiffusion:
Steady one-dimensional convection and diffusion. Central, upwind differencing schemespropertiesofdiscretization schemes. Conservativeness, Boundedness, Transportive, Hybrid,Power-law,QUICKSchemes.

UNIT-V:
CalculationFlowFieldbyFVM:
Representation of the pressure gradient term and continuity equation. Staggered grid. Momentumequations. Pressure and Velocity corrections; Pressure Correction equation, SIMPLE algorithmand itsvariants. Turbulence models, mixing length model, Two equation (k-Є) models. High andlow Reynoldsnumber models.

Courseoutcomes

Uponcompletionofthecourse,studentswillbeableto:

1. Usenumericalmethodsforsolvingvariousfluidandheattransferproblems.
2. Havebetterunderstandingoffluidmechanicsandheattransfer

3. FormulatesteadyandunsteadyFinite-Difference&Finite-Volumenumerical methods and develop solution algorithms.
4. ProgramandsimulatesimpleCFDproblems
5. UnderstandtheCFDroleinindustrialdesignapplicationsanditslimitation

Booksand References:

1. AnIntroductiontoComputationalFluidDynamics:TheFiniteVolumeMethod,byVersteeg, Pearson,
India.
2. NumericalHeatTransferandFluidFlow,byPatankar,Tayers&Francis.
3. ComputationalHeatTransfer,byJaluriaansTorrance,CRCPress.
4. ComputationalFluidDynamics,byAnderson,McGrawHill.
5. ComputationalFluidDynamics,byChung,CambridgeUniversityPress.
6. ComputerSimulationofflowandheattransfer,byGhoshdastidarMcGrawHill.
7. IntroductiontoComputationalFluidDynamics,byProdipNiyogi.PearsonIndia.
8. ComputationalFluidFlowandHeatTransfer,byMuralidharandSundararajan,NarosaPublishing House.
9. ComputationalFluidDynamics:PrinciplesandApplications,byBlazek,ElsevierScience&Techn ology.

AutomotiveTransmission

(BTME703D)

SubjectCode: BTME703D	AutomotiveTransmission	LTP:300	Credits:3

CourseObjective

The**objective**of the**course**is to provide comprehensive knowledge on various **transmission**systems and theircomponentssuchasgearboxesandhydraulicdrives.Italsoimpartsunderstandingof various **automatic transmission** systems and their applications along with hydrostatic and electric drives.

UNIT-I:

Clutchandgearbox:

Requirement of transmission system, Different types of clutches, principle & Construction of Single plate coil spring and Diaphragm spring clutches., Need and Objectives of Gear box. Construction and operationof Sliding mesh, Constant mesh and Synchromesh gearboxes. – Determination of gear ratios for vehicles. Performance characteristics in different speeds. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & Power and acceleration.

UNIT-II:

Hydrodynamictransmission:

Fluidcoupling-Principle-Constructional details. Torque capacity. Performance characteristics. Reduction of dragtorqueinfluidcoupling.TorqueconverterPrincipleconstructionaldetails,performancecharacteristics. Multistage torque converters and Poly phase torque converters.

UNIT-III:

Epicyclicgearboxesusedinautomatictransmission:

PrincipleofPlanetarygeartrains–WilsonGearbox,Octalelectromagnetictransmission-Hydrauliccontrol system for Automatic Transmission.

UNIT-IV:

Automatictransmissionapplications:

Need for automatic transmission, Four speed longitudinally mounted automatic transmission – Chevrolet "Turboglide" Transmission, Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT.

UNIT-V:

Hydrostaticandelectricdrive:

Hydrostatic drive; Various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive. Electric drive-types- Principle of early and modified Ward Leonard Control system-Advantages & limitations.

CourseOutcomes(COs)	Description
CO1	Thestudentwillbeabletounderstandtheworkingofclutchandgear box.

CO2	Studentswilllearntheconceptsandworkingoftorque converter.
CO3	Studentwilllearntheworkinganduseofepicyclicgearboxesusedin automatic transmission.
CO4	Thestudentwillbeabletounderstandtheneedof Automatic transmission**.**
CO5	Studentwilllearntheworkingprincipleof Hydrostaticandelectric drive**.**

Booksand References:

1. Heldt,P.M.,"Torqueconverters",ChiltonBookCo.,1962.
2. NewtonandSteeds,"Motorvehicles",IlliffePublishers, 1985.
3. Devaradjane.Dr.G.,Kumaresan.Dr.M.,"AutomobileEngineering",AMKPublishers, 2013.
4. Hydrostatictransmissionsforvehicleapplications,IMechEConference,1981-88.
5. Crouse,W.H.,Anglin,D.L.,"AutomotiveTransmissionandPowerTrainsconstruction", McGraw Hill, 1976.
6. HeinzHeisler,"AdvancevehicleTechnology",Butterworth-Heinemann,2002.

LeanManufacturing

(BTME703E)

SubjectCode: BTME703E	**Lean Manufacturing**	**LTP:300**	**Credits:3**

CourseObjective

To understand **lean management** principles & provides an understanding of factors that contribute to organizational wastes, examining ways to eliminate wastes, & developing & implementing an improved organizational processes, for significant impact to the company's bottom line.

UNIT-I:
Overview:
SEVEN forms of waste and their description; Historical evolution of lean manufacturing; Global competition, Customer requirements, Requirements of other stake holders. Meaning of Lean Manufacturing System (LMS), Meaning of Value and waste, Need for LMS, Symptoms of underperforming organizations, Meeting the customer requirement, Elements of LMS.

UNIT-II:
PrimarytoolsusedinLMS:
Meaning and Purpose of 5S Work place organization, 5S process – Sort, set in order, Shine, Standardize, Sustain, implementing 5S. Meaning and purpose of TPM, Pillars of TPM, Conditions for TPM success, TPM implementation process, Overall Equipment Effectiveness and problems on computation of OEE.

UNIT-III:
Process Mapping and Value Stream Mapping (VSM) – Need for process maps, advantages, types and its construction, steps in preparing VSM. Concept of work Cell and its design, Line balancing algorithms and problems.

UNIT-IV:
Secondarytoolsusedin LMS:
Causeandeffectdiagram,Paretochart,Radarchart,PokeYoke,Kanban,Automation,SMED,Standardized fixture,DFMA,JIT.Visualworkplace,problemsonParetoanalysisandcomputationofnumberofkanbans.

UNIT-V:
LMSRules:
Stability, Management, Standardized work, Pull system, Continuous improvement. Lean Implementation: Training, selecting the projects, preparing project charter, project implementation, Project review. Implementing LMS for higher productivity: Operator, process, machinery and equipment, workplace organization, Inventory, LMS Design Process.

CourseOutcome

CO1Explaintheapproachesto,concepts,andtheoriesofLeanManufacturing,includingkeyaspectsof Just in Time and Six Sigma.

CO2ApplyWorldClassManufacturing(WCM)techniquestoeffectcontinuousimprovement.

CO3ApplyAnalyticalTroubleshooting(ATS)techniquestotechnicalproblemsolvinganddecision making.

CO4Explainpeoplemanagementissuesanddiscusshowtheycanbeaddressed.

Booksand References:

1. N.Goplakrishnan,SimplifedLeanManufacture,PHI, 2010.
2. PascalDennis,LeanProductionSimplified,ProductivityPress,2007.
3. CreatingaKaizenCulture(2013)byJonMiller,MikeWroblewskiandJaime Villafuerte.
4. TheLeanTurnaround(2012)byArt Byrne.
5. TheToyotaProductionSystem:BeyondLarge-ScaleProduction(1988)byTaiichi Ohno.
6. OutoftheCrisis(1986)byW.Edwards Deming.
7. JeffreyLiker,TheToyotaWay,TataMcGraw-Hill,2004

OpenElective-II
DigitalandSocialMediaMarketing
(BTMEOE704A)

SubjectCode: BTME704A	**DigitalandSocialMediaMarketing**	**LTP:300**	**Credits:3**

COURSEOBJECTIVE

- Introduce current and core practices of Digital and Social Media Marketing that will allow learners to analyses, plan, execute and evaluate a digital marketing strategy.
- IntroducecoretoolscurrentlyusedinDigitalandSocialMediaMarketingthatwillallowlearnersto analyses, plan, execute and evaluate a digital marketing strategy.
- DevelopanunderstandingofSearchEngineOptimization(SEO),SocialMediaOptimization, Affiliate and other relevant communication channels for engagement of digital communities.

UNIT-I

Introduction to Digital Marketing: The new digital world - trends that are driving shifts from traditional marketing practices to digital marketing practices, the modern digital consumer and new consumer's digital journey. Marketing strategies for the digital world-latest practices. **[8]**

UNIT-II

Social Media Marketing -Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post, Content Planning and writing. Introduction to Face book, Twitter, Google +, LinkedIn, YouTube, Instagram and Pinterest; their channel advertising and campaigns

[8]

UNIT-III

Acquiring&EngagingUsersthroughDigitalChannels:Understandingtherelationshipbetweencontentand branding and its impact on sales, search engine marketing, mobile marketing, video marketing, and social-media marketing. Marketing gamification, Online campaign management; using marketing analytic tools to segment, target and position; overview of search engine optimization (SEO).

[8]

UNIT-IV

DesigningOrganizationforDigitalSuccess:Digitaltransformation,digitalleadershipprinciples,online P.R.andreputationmanagement.ROIofdigitalstrategies,howdigitalmarketingisaddingvalueto business, and evaluating cost effectiveness of digital strategies **[8]**

UNIT-V

Digital Innovation and Trends: The contemporary digital revolution, digital transformation framework; security and privatization issues with digital marketing Understanding trends in digital marketing – Indian and global context, online communities and co-creation.

[8]

COURSEOUTCOMES

Throughsuccessfulcompletionofthiscourse,students will:

- Understandwhatsocialmediais,thevariouschannelsthroughwhichitoperates,anditsrolein marketing strategy.
- Use principles of consumer and social psychology to develop social media content and campaigns that engage consumers.
- Drawonknowledgeaboutword-of-mouthmarketingtodevelopeffectiveapproachesfor propagating ideas, messages, products, and behaviors across social networks.
- Measuretheimpactofasocialmediacampaignintermsofaspecificmarketingobjective

Text books:

1. MoutsyMaiti:InternetMareting,OxfordUniversityPressIndia
2. Vandana,Ahuja;DigitalMarketing,OxfordUniversityPressIndia(November,2015).
3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional (October, 2013).
4. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page (3rd Edition, 2014).
5. TracyL.Tuten&MichaelR.Solomon:SocialMediaMarketing(SagePublication)

IdeatoBusinessModel

(BTMEOE704B)

SubjectCode: BTME704B	**IdeatoBusiness Model**	**LTP:300**	**Credits:3**

CourseObjectives:

- This course can motivate students to have an overall idea how to start and sustain a businessenterprise.
- Thestudentswilllearnbasicsofchoosinganideaofabusinessmodel.
- The core areas of choosing a business model are encompassed with Entrepreneurship development, PPC & communication system. The students will thus develop basic competencies how to run a business enterprise.

Unit-IIntroduction

Search for a business idea- How to choose an idea- Product idea- selection of product- The adoption process- Product innovation- Production , planning and development strategy- New product idea.**[8]**

Unit-II Introduction to Entrepreneurship - Meaning and concept of entrepreneurship- Difference between Entrepreneurship & wage employment - Functions of an Entrepreneur.- Entrepreneur vs Managerrole of entrepreneurship in economic development – Barriers to entrepreneurship.**[8]**

Unit-III The Entrepreneur - types of entrepreneurs- Competencies required to become an entrepreneur - Creative and Design Thinking, the entrepreneurial decision process- The process of Entrepreneurial development prog (EDP)- Evaluation of EDP - Entrepreneur development training.

[8]

Unit-IV Productionsystem-Designofproductionsystem-Typesofproductionsystem-Production,planning & control (PPC) - Steps of PPC. **[8]**

Unit-V Communication- Importance of communication system - barriers to communication - listening topeople- the power of talk - personal selling - risk taking & resilience - negotiation. **[8]**

CourseOutcome:

- Examinethechallengesassociatedwithdefiningtheconceptsofentrepreneurand entrepreneurship
- Discusshowtheevolutionofentrepreneurshipthoughthasinfluencedhowweviewtheconceptof entrepreneurship today

- Discusshowthelistofbasicquestionsinentrepreneurshipresearchcanbeexpandedtoinclude research inquiries that are important in today's world
- Discusshowtheconceptsofentrepreneurialuniqueness,entrepreneurialpersonalitytraits,and entrepreneurial cognitions can help society improve its support for entrepreneurship
- Applythegeneralventuringscripttothestudyofentrepreneurship

Text Books:

1. EntrepreneurshipDevelopment-SangeetaSharma,Kindleedition
2. Production&operationsManagement-KanishkaBedi,
3. MarketingManagement-PhilipKotler.
4. TheBusinessModelBook:Design,buildandadaptbusinessideasthatdrivebusinessgrowth: Adam Bock , Gerard George

MachineLearning
(BTMEOE704C)

SubjectCode: BTME704C	**MachineLearning**	**LTP:300**	**Credits:3**

CourseObjectives:

1. TointroducestudentstothebasicconceptsandtechniquesofMachineLearning.
2. TobecomefamiliarwithregressionmethodsclassificationmethodsclusteringmethodsMachineLearning.
3. TobecomefamiliarwithDimensionalityreductionTechniques.

UNIT-I

INTRODUCTION– Welldefined learning problems,Designing aLearning System,IssuesinMachine Learning; **THECONCEPTLEARNINGTASK**-General-to-specificorderingofhypotheses,Find-S,Listthen eliminate algorithm, Candidate elimination algorithm, Inductive bias. **[8]**

UNIT-II

DECISION TREE LEARNING - Decision tree learning algorithm-Inductive bias- Issues in Decision treelearning;

ARTIFICIAL NEURAL NETWORKS – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of back propagation rule Back propagation Algorithm Convergence, Generalization. **[8]**

UNIT-III

EvaluatingHypotheses: EstimatingHypotheses Accuracy, Basics of samplingTheory, ComparingLearning Algorithms; Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naive Bayes classifier, Bayesian belief networks, EM algorithm. **[8]**

UNIT-IV

Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for InfiniteHypothesisspaces,TheMistakeBoundModelofLearning;INSTANCE-**BASEDLEARNING**–k-NearestNeighbor Learning, Locally Weighted Regression, Radial basis function networks, Case based learning. **[8]**

UNIT-V

Genetic Algorithms: an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules sequential covering algorithms-General to specific beam search-FOIL;

REINFORCEMENTLEARNING -TheLearningTask,QLearning. **[8]**

CourseOutcomes: Attheendofthiscoursestudentswilldemonstratetheabilityto:

1. GainknowledgeaboutbasicconceptsofMachineLearning

2. Identifymachinelearningtechniquessuitableforagivenproblem
3. Solvetheproblemsusingvariousmachinelearningtechniques
4. ApplyDimensionalityreductiontechniques.
5. Designapplicationusingmachinelearningtechniques.

Text books:

1. TomM.Mitchell,—MachineLearning,McGraw-HillEducation(India)PrivateLimited,2013.
2. EthemAlpaydin,—IntroductiontoMachineLearning(AdaptiveComputationandMachine Learning), The MIT Press 2004.
3. StephenMarsland,—MachineLearning:AnAlgorithmicPerspective,CRCPress,2009.
4. Bishop,C.,PatternRecognitionandMachineLearning.Berlin:Springer-Verlag.

RenewableEnergyResources
(BTMEOE704D)

SubjectCode: BTME6704D	**RenewableEnergyResources**	**LTP:300**	**Credits:3**

CourseObjectives:

1. Understandthevariousformsofconventionalenergyresources.
2. Learnthepresentenergyscenarioandtheneedforenergyconservation
3. Explaintheconceptofvariousformsofrenewable energy
4. Outlinedivisionaspectsandutilizationofrenewableenergysourcesforbothdomesticsandindustrial application
5. Analysetheenvironmentalaspectsofrenewableenergyresources.

UNIT-I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

SolarCells:Theoryofsolarcells.Solarcellmaterials,solarcellarray,solarcellpowerplant, limitations. **[8]**

UNIT-II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal powerplants, thermal energy storage for solar heating and cooling, limitations. **[8]**

UNIT-III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Cells: Principle of working of various types of fuel cells and their working, performance and limitations. **[8]**

UNIT-IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems. **[8]**

UNIT-V

Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance a nd limitations.

WaveandTidalWave:Principleofworking,performanceandlimitations.WasteRecyclingPlants.

[8]

CourseOutcomes: Attheendofthiscoursestudentswilldemonstratetheabilityto:

1. Describetheenvironmentalaspectsofnon-conventionalenergyresources.InComparisonwith various conventional energy systems, their prospects and limitations.
2. Knowtheneedofrenewableenergyresources,historicalandlatest developments.
3. Describetheuseofsolarenergyandthevariouscomponentsusedintheenergyproductionwith respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
4. AppreciatetheneedofWindEnergyandthevariouscomponentsusedinenergygenerationand know the classifications.
5. UnderstandtheconceptofBiomassenergyresourcesandtheirclassification,typesofbiogasPlants-applications
6. CompareSolar,Windandbioenergysystems,theirprospects,Advantagesandlimitations.
7. Acquiretheknowledgeoffuelcells,wavepower,tidalpowerandgeothermalprinciplesand applications.

Text books:

1. Rajaetal,"IntroductiontoNon-ConventionalEnergyResources"ScitechPublications.
2. JohnTwideuandTonyWeir,"RenewalEnergyResources"BSPPublications,2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.
4. D.S.Chauhan,"Non-conventionalEnergyResources"NewAge International.
5. C.S.Solanki,"RenewalEnergyTechnologies:APracticalGuideforBeginners"PHI Learning.
6. PeterAuer,"AdvancesinEnergySystemandTechnology".Vol.1&IIEditedbyAcademicPress.
7. GodfreyBoyle,"RenewableEnergyPowerForASustainableFuture",OxfordUniversityPress.

OperationsResearch

(BTMEOE704E)

SubjectCode: BTME704E	OperationsResearch	LTP:300	Credits:3

CourseObjectives:

The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.

UNIT-I

Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis. **[8]**

UNIT-II

Transportation Problems: Types of transportation problems, mathematical models , transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines. **[8]**

UNIT-III

Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT. **[8]**

UNIT-IV

Theory of Games : Rectangular games, Minimax theorem, graphical solution of 2x nor mx2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queing model, single server models. **[8]**

UNIT-V

Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipments that deteriorate with time, equipments that fail with time.

[8]

CourseOutcomes(COs)	Description
CO1	Studentwillabletoformulateandobtaintheoptimalsolutionfor Linear Programmingproblems.
CO2	Studentwillabletodeterminetheoptimalsolutionfor Transportation andassignmentproblems.
CO3	StudentwillabletoPlan,ScheduleandControlthegiven project.
CO4	Studentwilllearntodetermine thebeststrategyandvalueofthegiven game model.
CO5	Studentwillabletounderstandtheneedofinventory management.

Text books:

1. WayneL.Winston,"OperationsResearch"ThomsonLearning, 2003.
2. HamdyH.Taha,"OperationsResearch-AnIntroduction"PearsonEducation,2003.
3. R.PanneerSeevam,"OperationsResearch"PHILearning,2008.
4. V.K.Khanna,"TotalQualityManagement"NewAgeInternational,2008.

ValueRelationship&EthicalHumanConduct–ForAHappy&HarmoniousSociety
(BTMEOE704F)

SubjectCode: BTME704F	**ValueRelationship&EthicalHumanConduct – For A Happy & Harmonious Society**	**LTP:300**	**Credits:3**

CourseObjectives:

1. Tohelpthestudentstounderstandtheimportanceandtypesofrelationshipwithexpressions.
2. Todevelopthecompetencetothinkabouttheconceptualframeworkofundividedsocietyaswellas universal human order.
3. Tohelpthestudentstodeveloptheexposurefortransitionfromcurrentstatetotheundivided society and universal human order.

UNIT-I

Relationship and role of work in its fulfilment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal HumanOrder, anappraisal ofthe Current State, Appraisal of Effortsinthis Direction in Human History.

UNIT-II

Understanding Human-Human Relationship & its fulfilment: Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfilment, Expression of feelings, Types of relationship and their purpose, mutual evaluation in relationship, Meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.

UNIT-III

Justice from family to world family order: Undivided Society as continuity and expanse of Justice in behaviour – family to world family order, continuity of culture and civilization, Universal Order on thebasis of Undivided Society, Conceptual Framework for Universal human order, Universal Human Order as continuity and expanse of order in living: from family order to world family order, a conceptual framework for universal human order.

UNIT-IV

Program for Ensuring Undivided Society and Universal Human Order: Education –Sanskar, Health – Sanyam, Production-work, Exchange – storage, Justice-preservation.

UNIT-V

Human Tradition: Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.

Courseoutcomes:

1. The **outcomes** of this course is exploration and thus universally adaptable. It involves a systematic and rational study of the human being vis-a-vis the rest of existence.
2. Itisfreefrom anydogmaorsetofdo'sanddon'tsrelatedto values.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. Thisprocessofself-explorationtakestheformofadialoguebetweentheteacherandthestudentsto begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their preconditioning and present beliefs. Introduction to the course: Basic aspiration of a Human Being and program for its fulfilment,NeedforfamilyandrelationshipforaHumanBeing,Humanhumanrelationshipandrole of behavior in its fulfillment, Human-rest of Nature

Text books:

1. AFoundationCourseinHumanValuesandProfessionEthics(TextBookandTeachers'Manual),
1. R.R.Gaur,R.Asthana,G.P.Bagaria(2010),ExcelBooks,NewDelhi.
2. AvartansheelArthshastra,A.Nagraj,DivyaPathSansthan,Amarkantak,India.
3. An Appeal bytheDalai Lama tothe World: Ethics Are More Important ThanReligion, Dalai Lama XIV, 2015.
4. EconomyofPermanence–(aquestforsocialorderbasedonnon-violence),J.C.Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India.
5. EnergyandEquity,IvanIllich(1974),TheTrinityPress,Worcester&HarperCollins,USA.
6. HumanSociety,KingsleyDavis,1949.
7. HindSwarajor,IndianhomeruleMohandasK.Gandhi, 1909.
8. IntegralHumanism,DeendayalUpadhyaya,1965.
9. LohiyaKeVichar,LokBharti,RammanoharLohiya,2008.
10. ManavVyavaharDarshan,A.Nagraj,DivyaPathSansthan,Amarkantak,India.
11. ManaviyaSanvidhan,A.Nagraj,DivyaPathSansthan,Amarkantak,India
12. SamadhanatmakBhautikvad,A.Nagraj,DivyaPathSansthan,Amarkantak,India
13. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher,1973, Blond & Briggs, UK.
14. SlowisBeautiful,CecileAndrews(http://www.newsociety.com/Books/S/Slow-is-Beautiful)
15. Sociology Themes and Perspectives, Harper Collins; EIGHT edition (2014), Martin Holborn andPeter Langley, 1980.
16. Samagra kranti: Jaya Prakash Narayan's philosophy of social change, Siddharth Publications Renu Sinha, 1996.
17. Science&Humanism–towardsaunifiedworldview,P.L.Dhar&R.R.Gaur(1990), Commonwealth Publishers, New Delhi
18. VyavaharvadiSamajshastra,A.Nagraj,DivyaPathSansthan,Amarkantak,India.
19. VyavahatmakJanvad,A.Nagraj,DivyaPathSansthan,Amarkantak,India.
20. TheCommunistManifesto,KarlMarx,1848.
21. TowardaTrueKinshipofFaiths:HowtheWorld'sReligionsCanComeTogetherDalaiLamaXIV, 2011

ReferenceVideos.

1. Kinschool(30 minutes)
2. Technology(SolarCityetc.).
3. Natural Farming.
4. EconomicsofHappiness(1h8m).

Mini Project
(BTME706P)

SubjectCode:BTME706P	MiniProject	L T P:0 02	Credits:2

CourseObjectives:

1. ToprovidestudentsforknowledgeofElectronicsComponentsandsolderingtechniquesandits package information for electronics circuit design.

2. KnowledgefortheassemblingofelectronicscircuitwithcomponentsonPCB(PrintedCircuit Board) of circuit design.

3. DesignanddevelopmentofSmallelectronicprojectbasedonhardwareandsoftwarefor electronics systems.

Studentswillbeaskedtoworkuponminimumonetopicduringthe semester.

They will submit the report of each topic containing following information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

CourseOutcome:Attheendofthiscourse,studentswillbeableto:

1. Studentswillbeabletopracticeacquiredknowledgewithinthechosenareaoftechnologyfor project development.

2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive andsystematic approach.

3. Reproduce,improveandrefinetechnicalaspectsforengineeringprojects.

4. Workasanindividualorinateamindevelopmentoftechnical projects.

5. Communicateandreporteffectivelyprojectrelatedactivitiesandfindings.

InternshipAssessment

(BTME707P)

SubjectCode:BTME707P	InternshipAssessment	L T P:0 02	Credits:2

Courseobjectives

Toexplorecareeralternativespriortograduation. Integrate

theory and practice.

Assessinterestsandabilitiesintheirfieldof study

CourseOutcomes:

Uponsuccessfulcompletion,participantswillhavetheknowledgeandskillsto:

1. Acquireonjobtheskills,knowledge,andattitude,whicharerequisiteto constitute a professional identity.
2. Demonstrateprofessionalvaluesandethicalstandards
3. Abilitytohandlereallifechallengesbymakingeffectivedecisionsatthe organizations
4. Adapteffectivelytochangingconditions

ProjectManagement&Entrepreneurship (BTME801)

SubjectCode:BTME801	ProjectManagement&Entrepreneurship	L T P:300	Credits:3

Courseobjectives

ToidentifytheelementsofthePMlifecycle,includingplan,control,andorganizeandallocate resources.

UnderstandPMprocesses.Comprehendandbecomefamiliarwiththeuseofbasictoolsand techniques to plan, organize, and manage a project.

Optimizeresultswhilemanagingthetripleconstraints

Unit	Topics	Lectures
I	**Entrepreneurship:** Entrepreneurship: need, scope , Entrepreneurial competencies & traits, Factors affecting entrepreneurial development, Entrepreneurial motivation (Mc Clellend's Achievement motivation theory), conceptual model of entrepreneurship , entrepreneur vs. intrapreneur; Classification of entrepreneurs; EntrepreneurialDevelopmentProgrammes	8
II	**Entrepreneurial Idea and Innovation:** Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities, Management skills for Entrepreneurs and managing for Value Creation, Creating and Sustaining Enterprising Model & OrganizationalEffectiveness	8
III	**Project Management:** Project management: meaning, scope & importance, role of project manager; project life-cycle Project appraisal: Preparation of a real time project feasibility report containing Technical appraisal,; Environmental appraisal, Market appraisal (including market surveyforforecastingfuturedemandandsales)andManagerial appraisal.	8
IV	**Project Financing:** Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation , preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed project report, Projectfinance.	8
V	**Social Entrepreneurship:** Social Sector Perspectives and Social Entrepreneurship, Social Entrepreneurship Opportunities and Successful Models,SocialInnovations andSustainability,MarketingManagement for Social Ventures, Risk Management in Social Enterprises, Legal Framework for Social Ventures.	8

CourseOutcomes(COs)	Description
CO1	Thestudentswillbeabletolearntheconcept Entrepreneurship.
CO2	Thestudentswillbeabletodevelop EntrepreneurialIdeaandInnovation
CO3	Thestudentswillbeabletolearn Projectmanagement:meaning,scope&importance
CO4	Thestudentswillbeabletolearn Projectcostestimation&working capital requirements, sources of funds, capital budgeting, Risk & uncertaintyin project evaluation
CO5	ThestudentswillbeabletolearnSocialEntrepreneurship

TextBook:

1. InnovationandEntrepreneurshipbyDrucker,P.F.;HarperandRow
2. Business,EntrepreneurshipandManagement:Rao,V.S.P.;Vikas
3. Entrepreneurship:RoyRajeev;OUP.
4. TextBookofProjectManagement:Gopalkrishnan,P.andRamamoorthy,V.E.; McMillan
5. ProjectManagementforEngineering,BusinessandTechnology:Nicholas,J.M., and Steyn, H.; PHI
6. ProjectManagement:TheManagerialProcess:Gray,C.F.,Larson,E.W.and Desai, G.V.; MGH

DepartmentalElective-VI

SubjectCode:BTME802A	FlexibleManufacturing	L T P:300	Credits:3

Courseobjectives

To improve efficiency and thus lower a company's production cost. Flexible manufacturing also can be a key component of a make-to-order strategy that allows customers to customize the products they want. Such flexibility can come with higher upfront costs.

UNIT-I:UnderstandingofFMS

IntroductionToFMS,EvolutionofManufacturingSystems,objectiveandNeed,Benefits,

Components,TypesofFlexibility,Merits,DemeritsandApplicationsofFlexibility.

Composition of FMS, CNC machines, robots, automatic storage and retrieval, automatic material handling, computerized control, Hierarchy of Computer Control ,Computer Control of Work Centre and Assembly Lines, FMS Supervisory Computer Control.

UNIT-II:Planning,schedulingandcontrolofflexiblemanufacturingsystems: Process planning, machine loading, cycle time, machine output vs cycle time, methods to reduce cycle time, machine balancing.

Scheduling, data requirement for scheduling, mater production scheduling, Gantt charts, schedulingrules, scheduling in FMS, Single Product, Single Batch, N–Batch Scheduling Problem, KnowledgeBased Scheduling System.

Dispatching,Dispatchactivities.

UNIT-III:**FMSsimulationanddata base**
Application of Simulation, Model of FMS, Simulation Software, Limitation, Manufacturing Data Systems, Data Flow, FMS Database Systems, Planning For FMS Database.

DesignofFMS: PerformanceEvaluationofFMS,AnalyticalmodelandSimulationmodelof FMS.

UNIT-IV:GrouptechnologyandjustificationofFMS

Introduction, Matrix Formulation, Mathematical Programming Formulation, Graph Formulation, Knowledge Based System for Group Technology, Economic Justification Of FMS, Implementationissues and maintenance of FMS, Application of Possibility Distributions in FMS Systems Justification.

UNIT-V:ApplicationsofFMSandfactoryofthe future

FMSApplicationinMachining,SheetMetalFabrication,PrismaticComponentProduction, AerospaceApplication, FMS Development Towards Factories of The Future, Artificial Intelligence and Expert Systems in FMS, Design Philosophy and Characteristics for Future, case studies.

CourseOutcomes:Thestudentswillbeableto		**Blooms Taxonomy**
CO-1	Understandthemanufacturingsystems,flexibility,componentsofFMS	K2
CO-2	Understandproduction,planning,schedulingandsimulationofFMS	K2
CO-3	Understandconceptsofgrouptechnologyandeconomicsissuesinthe application of FMS	K2
CO-4	UnderstandtheapplicationofFMSinvariousoperations&involvementofAIin flexible manufacturing system.	K2
CO-5	ApplytheconceptsofschedulingandsimulationinFMS	K3

Booksand References:

1. Jha,N.K."HandbookofFlexibleManufacturingSystems",AcademicPressInc.,1991.
2. Radhakrishnan P.And Subramanyan S.,"CAD/CAM/CIM", WileyEastern Ltd.,New Age International Ltd., 1994.
3. Raouf,A.AndBen-Daya,M.,Editors,"FlexibleManufacturingSystems:RecentDevelopment", Elsevier Science, 1995.
4. GrooverM.P.,"Automation,ProductionSystemsAndComputerIntegratedManufacturing", Prentice Hall Of India Pvt., New Delhi, 1996.
5. RezaAMaleki"FlexibleManufacturingsystem"PrenticeHallofIncNewJersey, 1991
6. TaiichiOhno,"ToyotaProductionSystem:BeyondLarge-ScaleProduction",ProductivityPress (India) Pvt. Ltd. 1992.

SubjectCode:BTME802B	AdvanceManufacturingScience	L T P :300	Credits:3

Courseobjectives

The goal of advanced manufacturing is toincrease output while optimizing value, quality, market responsiveness and flexibility. Advanced manufacturing also aims to reduce time to market, material inventory and content and unit quantities

UNIT-1

Introduction **(3Hours)**

Types of advanced manufacturing processes, Evolution, need, and classification of advanced machining processes.

AdvancedMachiningProcesses **(5Hours)**

Introduction Need & benefits, application and working principle, Advantages & Disadvantages of Abrasive jet machining (AJM) Water jet machining (WJM) Abrasive water jet machining (AWJM), Advanceabrasive finishing process, Abrasive Flow Finishing, Magnetic Field Assisted Abrasive Finishing, Magneto Rheological Finishing.

UNIT-2

AdvancedMachiningProcessescontinued... **(7Hours)**

Process principle, Mechanism of material removal, Process Parameters, Process Capabilities, and Applications of Electrochemical machining (ECM), Electro discharge machining (EDM), Electron beam machining (EBM), Laser beam machining (LBM) processes.

UNIT-3

AdvancedMetalFormingProcesses **(6Hours)**

Details of high energy rate forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming and Contour roll forming.

UNIT-4

AdvancedCastingProcesses **(7Hours)**

Metal mould casting, Continuous casting, Squeeze casting, Vacuummould casting, Evaporative pattern casting, Ceramic shell casting.

AdvanceWeldingProcesses: Magneticarcwelding,Frictionwelding,Explosivewelding, Ultrasonic welding, Laser welding, Electron beam welding

UNIT-5 **(8Hours)**

Derived and Hybrid Modern manufacturing Methods: Introduction of process like rotary ultrasonic machining ,electro stream drilling, shape tube electro machining, wire electro discharge machining, electro chemical grinding, electro chemical honing, electro chemical deburring and electro chemical spark machining.

CourseOutcomes:Thestudentswillbeableto		**Blooms Taxonomy**
CO-1	Understandtheprinciplesofmaterialremovalmechanismofadvanced machining processes.	K2
CO-2	Understandthebasicconcept ofadvancemetalforming processes.	K2
CO-3	Understandthebasicconcept ofadvancecasting processes.	K2
CO-4	Understandthebasicconceptsofadvancewelding process.	K2
CO-5	Understandvarioushybridmodernmanufacturingmethods.	K2

ReferenceBooks:-

1. "Materials andProcessesin Manufacturing" (8th Edition),E.P. DeGarmo,J.T Black,R.A.Kohser, Prentice Hall of India, New Delhi (ISBN 0-02-978760).
2. "ManufacturingScience"A.Ghosh,andA.K.Mallik,AffiliatedEast-WestPressPvt.Ltd.NewDelhi.
3. "NontraditionalManufacturingProcesses",G.F.Benedict,MarcelDekker,Inc.NewYork(ISBN0- 8247-7352-7).
4. H.AbdelandG.El-Hofy,AdvancedMachiningProcesses:NontraditionalandHybridMachining Processes, 1 st edition, McGraw-Hill Professional, 2005. ISBN: 978- 0071453349.

SubjectCode:BTME802C	HybridVehiclePropulsion	L T P :300	Credits:3

Courseobjectives

ToDesignrequirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle.

VariousResistance-Transmissionefficiency-ElectricvehiclechassisandBodyDesign,ElectricVehicle Recharging and Refueling Systems

UNITI

IntroductiontoHybridElectricVehicles: [L-4Hours]

Historyofhybridandelectricvehicles,socialandenvironmentalimportanceofhybridandelectricvehicles, impact of modern drive-trains on energy supplies.

ConventionalVehicles: [L-4Hours]

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNITII

HybridElectricDrive-trains: [L-4Hours]

Basic conceptof hybridtraction, introductiontovarious hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

ElectricDrive-trains: [L-4Hours]

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNITIII

ElectricPropulsionunit: [L-10Hours]

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNITIV

Energy Storage: **[L-5Hours]**

Introduction to Energy Storage RequirementsinHybridand ElectricVehicles,Battery based energystorage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizingthedrivesystem: **[L-4Hours]**

Matchingtheelectricmachineandtheinternalcombustionengine(ICE),Sizingthepropulsionmotor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNITV

EnergyManagementStrategies: **[L-8Hours]**

Introductiontoenergymanagementstrategiesusedinhybridandelectricvehicles,classificationofdifferent energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Thestudentswillbe ableto		**Blooms Taxonomy**
CO-1	Understandthebasicsofthehybridelectricvehiclesandit'stypes.	K2
CO-2	Understandthetypesofdrivetrainsusedinhybrid vehicles	K2
CO-3	UnderstandthepropulsionunitsusedinHybridVehiclesandtheirefficiency.	K2
CO-4	Understandtherequirementsanddevicesofenergystorageusedin hybrid vehicles.	K2
CO-5	UnderstandtheconceptofdownsizingofICenginesincaseofhybrid vehicles.	K2
CO-6	Understandtheprinciplesofenergymanagementandissuesrelatedto these strategies.	K2

Text Books:

1. IqbalHussein,ElectricandHybridVehicles:DesignFundamentals,CRCPress,2003.

2. MehrdadEhsani,YimiGao,SebastianE.Gay,AliEmadi,ModernElectric,HybridElectricand Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004.

ReferenceBooks:

1. JamesLarminie,JohnLowry,ElectricVehicleTechnologyExplained,Wiley,2003.

2. ChrisMi,M.AbulMasrur,DavidWenzhongGao, HybridElectricVehicles:PrinciplesandApplications with Practical Perspectives, John Wiley & Sons Ltd., 2011.

OPENELECTIVEIII

SubjectCode:BTMEOE803A	FILTERDESIGN	3L:0T:0P	3 Credits

COURSEOBJECTIVE: Studentsundergoingthiscourseareexpected to:

1. Understandaboutthecharacteristicsofdifferentfilters.
2. UnderstandtheconceptofApproximationTheory.
3. Learnabouttheswitchedcapacitorfilter.

Unit	Topics	Lectures
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulationand modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistivefeedback:NoninvertingandInverting,AnalysingOp-ampcircuits,Blockdiagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	8
II	First orderfilter:Bilineartransferfunctionsandfrequencyresponse– Bilineartransferfunctionanditsparts,realizationofpassiveelements,Bode plots,Activerealization,TheeffectofA(s),cascade design.	8
III	Secondorderlowpassandbandpassfilters:Designparameters,Secondordercircuit, frequency response of low pass and band pass circuits, Integrators and others biquads.	8
IV	Second order filters with arbitrary transmission zeros: By using summing, Byvoltage feed forward, cascade design revisited. Lowpassfilterswithmaximallyflatmagnitude:theideallowpassfilter,Butterworth response,Butterworthpolelocations,lowpassfilterspecifications,arbitrarytransmission	8
V	Low pass filter with equal ripple (Chebyshev) magnitude response: The chebyshev polynomial ,Thechebyshevmagnituderesponse,Locationofchebyshevpoles, Comparison ofmaximallyflat&equal–rippleresponses,Chebyshevfilter design Inversechebyshevandcauerfilters:Inversechebyshevresponse,From specificationsto poleandzerolocations,Cauermagnituderesponse,Chebyshevrationalfunctions,Cauer	8

COURSEOUTCOME: Aftercompletionofthecoursestudentwillbeableto:

CO1	Chooseanappropriatetransform forthegiven signal.
CO2	Chooseappropriatedecimationandinterpolationfactorsforhighperformancefilters.
CO3	Modeland design anARsystem.
CO4	ImplementfilteralgorithmsonagivenDSPprocessorplatform.

Text Book:

1. Rolf. Schaumann, Haiqiao Xiao, Mac. E. Van Valkenburg, “Analog Filter Design”, 2ndIndianEdition, Oxford University Press.

ReferenceBooks:

1. J.MichaelJacob,“ApplicationsandDesignwithAnalogIntegratedCircuits”,Second edition,Pearson.

2. T.Deliyannis,YichuangSun,J.K.Fidler,“Continuous-TimeActiveFilterDesign”,CRCPress.

SubjectCode: BTMEOE803B	BIOECONOMICS	3L:0T:0P	3 Credits

OBJECTIVE:

This course is designed with an objective to provide an understanding of the basic knowledge of bioecomics to students so that they can explore entrepreneurship opportunities in the bio based industry. This course also serves interdisciplinary innovation in terms of sustainable bioeconomy

Unit	Topics	Lectures
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulationand modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, AnalysingOp-ampcircuits,Blockdiagramsandfeedback,TheVoltage follower,Additionandsubtraction,ApplicationofOp-ampresistorcircuits.	08
II	Economic Growth, Development, and Innovation in terms of bioeconomy, Environmental Economics and the Role of Government, Modelling and Tools SupportingtheTransitiontoaBioeconomy,RoleofbiobasedEconomyin sustainabledevelopment.	08
III	Inter- and transdisciplinarity in Bioeconomy & research approaches, primary production,processingofbiobasedresources, Markets,SustainabilityManagementandEntrepreneurshipinbiobasedproducts.	08
IV	Biobased Resources and Value Chains, Processing of Biobased Resources, Markets, Sustainability Management and Entrepreneurship opportunity in biobased product. Food Security and Healthy Nutrition in the Context of the Bioeconomy,UseofBiomassfortheProductionofFuelandChemicals,The importanceofBiotechnologyfortheBioeconomy.	08
V	sustainableandinnovativeuseofbiomassandbiologicalknowledgetoprovide food, feed, industrial products, bioenergy and ecological services, importance ofbioeconomy-relatedconceptsinpublic,scientific,andpoliticaldiscourse, DynamicManagementofFossilFuel,Biofuel.	08

COURSEOUTCOME: Aftercompletionofthecoursestudentwillbeableto:

1. Students will be able to understand basic concept of Bioeconomics, challenges, opportunities&regulations
2. Studentswillbeabletounderstanddevelopmentandinnovationintermsofbioeconomy towards sustainable development
3. StudentswillbeabletounderstandInter-andtransdisciplinarityinbioeconomy&research approaches
4. Studentswillbeabletoexplainbiobasedresources,valuechain,innovativeuseofbiomassand biological knowledge to provide food, feed, industrial products

Text Book:

1. PrinciplesofBioeconomicsbyI.Sundar,VedamseBooks(P)LtdNewDelhi,India
2. Bioeconomy:ShapingtheTransition to aSustainable,BiobasedEconomyby IrisLewandowski, Springer.
3. SociobiologyandBioeconomicsbyKoslowski,Peter
4. Modeling, Dynamics, Optimization and Bioeconomics I, by Pinto, Alberto Adrego, Zilberman, David, Springer.

SubjectCode:BTMEOE803C	DesignThinking	3L:0T:0P	3Credits

Objective:

The objective of this course is to familiarize students with design thinking process as a tool for breakthroughinnovation. It aimstoequipstudentswithdesignthinkingskillsandignite the mindsto create innovative ideas, develop solutions for real- time problems

Unit	*Topics*	Lectures
I	Introduction to design thinking, traditional problem solving versus design thinking, history of design thinking, wicked problems. Innovation and creativity, the role of innovation and creativity in organizations, creativity in teams and their environments, design mindset. Introduction to elements and principles of design, 13 Musical Notes for DesignMindset,ExamplesofGreat Design, Design Approaches across the world	8
II	Understanding humans as a combination of I (self) and body, basic physical needsupto actualization,prosperity, the gapbetweendesires and actualization. Understanding culture in family society, institution, startup, socialization process. Ethical behavior: effects on self, society, understanding core values and feelings, negative sentiments and how to overcome them, definite human conduct: universal human goal, developing human consciousness in values, policy, and character. Understand stakeholders, techniques to empathize, identify key user problems. Empathy tools- Interviews, empathy maps, emotional mapping, immersion and observations, customer journey maps, and brainstorming, Classifying insights after Observations, Classifying Stakeholders, Do's & Don'ts for Brainstorming, Individual activity- 'Moccasin walk'	8
III	Defining the problem statement, creating personas, Point of View (POV) statements. Research- identifying drivers, informationgathering,targetgroups, samples, and feedbacks. Idea Generation-basic design directions, Themes of Thinking, inspirations and references, brainstorming, inclusion, sketching and presenting ideas, idea evaluation, double diamond approach, analyze – four W's, 5 why's, "How Might We", Defining the problem using Ice-Cream Sticks, Metaphor & Random Association Technique, Mind-Map, ideation activity games - six thinking hats, million-dollar idea, introduction to visual collaboration and brainstorming tools -Mural, JamBoard	8
IV	Fundamental concepts of critical thinking, the difference between critical and ordinary thinking, characteristics of critical thinkers, critical thinking skills-linkingideas,structuringarguments,recognizingincongruences,fivepillars of critical thinking, argumentation versus rhetoric, cognitive bias, tribalism,and politics. Case study on applying critical thinking on different scenarios.	8

V	The argument, claim, and statement, identifying premisesandconclusion,truth and logic conditions, valid/invalid arguments, strong/weak arguments, deductive argument, argument diagrams, logical reasoning, scientificreasoning, logical fallacies, propositional logic, probability, and judgment, obstacles to critical thinking. Group activity/role plays on evaluatingarguments.	8

Text Book:

1. Vijay Kumar, 101 Design Methods: AStructured Approach for Driving Innovation in Your Organization, 2013, John Wiley and Sons Inc, New Jersey
2. BPBanerjee,FoundationsofEthicsandManagement,2005,Excel Books
3. GavinAmbroseandPaulHarris,BasicsDesign08:DesignThinking,2010,AVA Publishing SA
4. RogerL.Martin,DesignofBusiness:WhyDesignThinkingistheNextCompetitive Advantage, 2009, Harvard Business Press, Boston MA

CourseOutcome: Aftersuccessfulcompletionofthecoursethestudentswillbeableto:

1. Develop a strong understanding of the design process and apply it in a variety of business settings
2. Analyzeself,culture,teamworktoworkinamultidisciplinaryenvironmentandexhibit empathetic behavior
3. Formulatespecificproblemstatementsofrealtimeissuesandgenerateinnovativeideas using design tools
4. Applycriticalthinkingskillsinordertoarriveattherootcausefromasetoflikelycauses
5. Demonstrateanenhancedabilitytoapplydesignthinkingskillsforevaluationofclaims and arguments.

Subject Code: BTMEOE803D	IntroductiontoWomen'sandGenderStudies	3L:0T:0P	3Credits

Courseobjectives

ToDefineandEvaluategenderasasocialconstruct.Identifythewaysgender,power,privilege,and oppression play out across a range of cultures and human experiences.

Demonstrateanunderstandingofgenderasitintersectswithsexuality,race,ethnicity,religion, class and other critical variables.

Unit	*Topic*	Lectures
I	**Women and Society:**Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Private and Public dichotomy, Sexual Division of Work, Patriarchy practicesindifferentinstitutionsandText Books.	8
II	**Feminist Theory:**Rise of Feminism, Introduction to various stands of Feminism- Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post Colonial Feminism, Post Modern Feminism. Waves of Feminism.	8
III	**Women's Movement:**The socio-economic conditions of women duringthe age of Industrial revolutionthe Call for Women's Rights 1848, Women's rights movement 1848-1920,Historical Developments of Social Reform Movements in India , Women's groups and organizations,Women's Movement Movements for Uniform Civil code and ShahBano case, Dalit women and the question of double marginality.	8
IV	**Gender Roles and Psychology of Sex:**Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic, Relationships Sex Differencesin Mental Health Trauma relating to Rape , Taboo , Childhood Sexual Abuse , Domestic Violence , Sexual Harassment at Work Place,Educational Institutions, Eve Teasing etc.	8
V	**Gender and Representation:**Gender and Mass Media- Print Media, Gender and Mass Media-Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.	8

Courseoutcomes:

- Understand Gender and Women's Studies as an academic field of study, be familiar withitsmajorconcepts, history,assumptions, and theories/theorists,and recognize its epistemological and methodological diversity and character.
- Recognize the intersections between gender and other social and cultural identities, including, but not limited to, race, ethnicity, national origin, religion, class and sexuality.

- Analyze the ways in which societal institutions and power structures impact the material realities of women's lives.
- Demonstrate adequate skills in listening, speaking, and writing effectively, performing critical thinking and analysis, incorporating feminist theoretical perspectives in problem solving and research methodologies.
- Evaluate and interpret information from a variety of sources including print and electronic media, film, video, and other information technologies.
- Articulate connections between global, regional, and local issues, and their relationship to women's experiences and to human rights, with an awareness of the importance of context.
- Engageinpromotingsocialjusticeandhumanrights.

Suggestedreading:

1. BasabiChakrabarti,Women'sStudies:VariousAspects.UrbiPrakashani2014
2. ArvindNarrain.Queer:DespisedSexualityLawandSocialChange.BookforChange. 2005
3. ChandraTalpadeMohanty,FeminismwithoutBorders:DecolonizingTheory,Practicing Solidarity. Duke University Press.
4. FlaviaAgnes.LawandGenderInequality:ThePoliticsofWomen'sRightsinIndia.

   OxfordUniversityPress,2001

5. SoniaBathla,Women,DemocracyandtheMedia:CulturalandPoliticalRepresentations in the Indian Press, Sage, New Delhi, 1998.

Subject Code: BTMEOE803E	**QualityManagement**	**3L:0T:0P**	**3Credits**

COURSEOBJECTIVE: Studentsundergoingthiscourseareexpectedto-

1. Introducetheimportanceofqualityinimprovingcompetitiveness.
2. UnderstandtheImplicationofQualityonBusiness.
3. ImplementQualityImplementationPrograms.
4. HaveexposuretochallengesinQualityImprovementPrograms.

Unit	Topic	Lectures
1	QualityConcepts:EvolutionofQualityControl,conceptchange,TQMModernconcept, Qualityconceptindesign,Reviewofdesign,Evolutionofprototype.Controlon Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality: Methodsand techniquesformanufacture,inspectionandcontrolofproduct,qualityinsales	**8**

2	QualityManagement:Organizationstructureanddesign,qualityfunction,decentralization, designingandfitting,organizationfordifferenttypeproductsandcompany,economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. HumanFactorinqualityAttitudeoftopmanagement,cooperationofgroups, operatorsattitude,responsibility,causesofapparatuserrorandcorrectivemethods.	**8**
3	ControlCharts,Theoryofcontrolcharts,measurementrange,constructionandanalysisof R charts,processcapabilitystudy,useofcontrolcharts.AttributesofControlChart, Defects,constructionandanalysisofcharts,improvementbycontrolchart,variablesample	**8**
4	Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure,factors affecting reliability,MTTF,calculationofreliability,building reliabilityintheproduct,evaluationofreliability,interpretationoftestresults,	**8**
5	ISO-9000anditsconceptofQualityManagement,ISO9000series,Taguchimethod,JITin somedetails.	**8**

CourseOutcomes(COs)	**Description**
CO1	Thestudentswillbeableto Realizetheimportanceofsignificanceofquality.
CO2	Thestudentswillbeableto Managequalityimprovement teams.
CO3	ThestudentswillbeabletoIdentifyrequirementsofqualityimprovementand measurement programs
CO4	Thestudentswillbeabletoidentificationandanalysisofdefects
CO5	Thestudentswillbeabletolearntheconceptof Quality Managementwith different methods

TextandReferenceBooks:

1. Lt.Gen.H.Lal,"TotalQualityManagement",EasternLimited,1990.
2. GregBounds,"BeyondTotalQualityManagement",McGrawHill,1994.

Menon,H.G,"TQMinNewProductmanufacturing",McGrawHill1992

Subject Code: BTMEOE803F	Modeling of Field-EffectNanoDevices	3L:0T:0P	3Credits

COURSEOBJECTIVE: Studentsundergoingthiscourseareexpectedto-

1. IntroducenovelMOSFETdevicesandunderstandtheadvantagesofmulti-gatedevices.
2. IntroducetheconceptsofnanoscaleMOStransistorandtheirperformancecharacteristics.
3. Studythevariousnano-scaledMOStransistor circuits.

Unit	Topic	Lectures
1	MOSFETscaling,shortchanneleffects-channelengineering- source/drain engineering - high k dielectric - copper interconnects - strain engineering, SOI MOSFET,multigatetransistors–singlegate–doublegate–triplegate– surroundgate,quantumeffects–volumeinversion–mobility–threshold voltage–intersubbandscattering,multigatetechnology–mobility–gatestack	8
2	MOSElectrostatics–1D–2DMOSElectrostatics,MOSFETCurrent- Voltage Characteristics–CMOSTechnology–Ultimatelimits,doublegateMOSsystem – gatevoltageeffect-semiconductorthicknesseffect–asymmetryeffect– oxide thickness effect – electron tunnel current – two dimensional confinement, scattering	8
3	SiliconnanowireMOSFETs–EvaluvationofI-Vcharacteristics–TheI-V characteristics for nondegenerate carrier statistics – The I-V characteristics for degeneratecarrierstatistics–Carbonnanotube–Bandstructureofcarbon nanotube –Bandstructureofgraphene–Physicalstructureofnanotube–Bandstructure of nanotube – Carbon nanotube FETs – Carbon nanotube MOSFETs – Schottky barriercarbonnanotubeFETs–Electronicconductioninmolecules–General	8
4	RadiationeffectsinSOI MOSFETs,totalionizingdoseeffects–single-gateSOI – multi-gate devices, single event effect, scaling effects	8
5	Digital circuits – impact of device performance on digital circuits – leakage performance trade off– multi VT devicesandcircuits – SRAM design,analog circuit design – transconductance - intrinsic gain – flicker noise – self heating –band gapvoltagereference–operationalamplifier–comparatordesigns,mixedsignal–	8

COURSEOUTCOME: Aftercompletionofthecoursestudentwillbeableto-

CO1: StudytheMOSdevicesusedbelow10nmandbeyondwithaneyeonthefuture.

CO2: Understandandstudythephysicsbehindtheoperationofmulti-gate systems.

CO3: DesigncircuitsusingNano-scaledMOStransistorswiththephysicalinsightoftheirfunctional Characteristics.

CO4: UnderstandandstudythephysicsbehindtheRadiationeffectsinSOIMOSFETs.

CO5: Understandtheimpactofdeviceperformanceondigitalcircuits.

TextandReferenceBooks:

1. JP Colinge,"FINFETsandothermulti-gate transistors",Springer –Serieson integratedcircuits and systems, 2008
2. Mark Lundstrom, Jing Guo, "Nanoscale Transistors: Device Physics, Modeling and Simulation", Springer, 2006
3. MSLundstorm,"FundamentalsofCarrierTransport",2ndEd.,CambridgeUniversityPress, Cambridge UK, 2000.

Subject Code: BTMEOE803G	ComputerizedProcessControl	3L:0T:0P	3Credits

COURSEOBJECTIVE: Studentsundergoingthiscourseareexpectedto-

1. UnderstandBasicsofComputer-AidedProcessControl.
2. AnalyzeIndustrialcommunicationSystem.
3. DesignProcessModellingforcomputerizedProcess control.
4. DesignAdvancedStrategiesForComputerizedProcesscontrol.
5. AnalyzeComputerizedProcessControl.

Unit	Topic	Lectures
1	BasicsofComputer-AidedProcessControl:Roleofcomputersinprocesscontrol, ElementsofacomputeraidedProcesscontrolSystem,ClassificationofaComputer –Aided Process Control System Computer Aided Process–control Architecture: Centralized ControlSystems,DistributedcontrolSystems, HierarchicalComputer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.	8
2	Industrial communication System: Communication Networking, Industrial communicationSystems,DataTransferTechniques,ComputerAided Process control software, Types of Computer control Process Software, Real Time Operating System	8
3	ProcessModellingforcomputerizedProcesscontrol:Processmodel,Physical model,ControlModel,Processmodelling.ModellingProcedure:GoalsDefinition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation	8
4	Advanced Strategies For Computerised Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	8
5	Examples of Computerized Process Control: Electric Oven Temperature Control, ReheatFurnaceTemperaturecontrol,ThicknessandFlatnesscontrolSystemfor metal Rolling, Computer-Aided control of Electric Power Generation Plant.	8

COURSEOUTCOME: Aftercompletionofthecoursestudentwillbeableto-

CO1: UnderstandtheRoleofcomputersinprocesscontrol,ElementsofacomputeraidedProcess control System, Classification of a Computer.

CO2: DesignPhaseLockedLocalLoop,Mixers.TimeDivisionMultiplexedSystem– TDM/PAM system.

CO3: RealizeProcessmodel,Physicalmodel,ControlModel.ModellingProcedure.

CO4: FormulateofCascadeControl,Predictivecontrol,AdaptiveControl,Inferentialcontrol, Intelligent Control, Statistical control.

CO5: DesignElectricOvenTemperatureControl,ReheatFurnaceTemperaturecontrol.

Text Books:

1. S.K.Singh,"ComputerAidedProcesscontrol", PHI.

ReferenceBooks:

1. C.L.Smith,"DigitalcomputerProcessControl",IdentEducationalPublishers.
2. C.D.Johnson,"ProcessControlInstrumentationTechnology",PHI.
3. KrishanKant,"ComputerBasedIndustrialControl"
4. Pradeep B. Deshpande & Raymond H. Ash, "Element of Computer Process Control with Advance Control Applications", Instrument Society of America, 1981.
5. C.M.Houpis&G.B.Lamond,"DigitalControlSystemTheory",TataMcGrawHill.

Project

SubjectCode: BTME804P

SubjectCode: BTME804P	**Project**	**LTP:002**	**Credits:2**

Courseobjectives

Toexplorecareeralternativespriortograduation. Integrate

theory and practice.

Assessinterestsandabilitiesintheirfieldof study

CourseOutcomes:

Uponsuccessfulcompletion,participantswillhavetheknowledgeandskillsto:

5. Acquireonjobtheskills,knowledge,andattitude,whicharerequisitetoconstitute a professional identity.
6. Demonstrateprofessionalvaluesandethicalstandards
7. Abilitytohandlereallifechallengesbymakingeffectivedecisionsatthe organizations
8. Adapteffectivelytochangingconditions