COURSE STRUCTURE AND SYLLABUS

For

B.Tech

MECHANICAL ENGINEERING

(*Applicable for batches admitted from 2016-17*)

PRAGATI ENGINEERING COLLEGE

(AUTONOMOUS)

Permanently Affiliated to JNTUK, Kakinada, Accredited by NAAC with "A" Grade
Recognized by UGC 2(f) and 12(b) under UGC act, 1956
1-378, ADB Road, Surampalem – 533 437
Near Peddapuram, E.G.Dist, Andhra Pradesh

PRAGATIENGINEERINGCOLLEGE:SURAMPALEM
(Autonomous)

ACADEMICREGULATIONSFORB.TECH(REGULAR)

ApplicableforthestudentsofB.Tech(Regular)Admittedfromtheacademicyear2016-2017.

1. AWARD OFB.TECHDEGREE

AStudentwillbedeclaredeligiblefortheawardofB.TechDegreeifhefulfillsthefollowingacademicregulations.

AStudentshallbedeclaredeligiblefortheawardoftheB.TechDegree,ifhepursuesacourseofstudy for notlessthan fourand fornot morethaneightacademicyears.

Thecandidateshallregisterfor180creditsandsecureallthe180 credits.

2. COURSESOF STUDY

ThefollowingcoursesofstudyareofferedatpresentasspecializationsfortheB.TechcoursewithEnglish asmediumofinstruction.

S.No.	*Branch/ Course*
01.	CivilEngineering(CE)
02.	ElectricalandElectronicsEngineering(EEE)
03.	MechanicalEngineering(ME)
04.	ElectronicsandCommunicationsEngineering(ECE)
05.	ComputerScienceandEngineering (CSE)
06.	InformationTechnology(IT)

3. MINIMUMINSTRUCTIONSDAYS.

Theminimuminstructiondaysforeachsemestershallbe 90workingdays

4. PROGRAMME/ COURSECREDITS

4.1.Eachdiscipline/courseofthefouryearB.Techprogrammeisdesignedtohaveatotalof 180 credits.Depending upon the nature of each subject and the number of periods ofinstructionwhetheritistheory,laboratory,drawingetc.,weightagesaregivenintermsofnumberofcredits.Seecoursestructurefordetails.

5. ATTENDANCEREQUIREMENTS:

AstudentiseligibletoappearfortheEndsemesterexaminationsonlyifheputsinaminimumof 75%ofattendanceinaggregateofallthesubjects.

Condonation of shortage of attendance in the aggregate upto 10% (65% and above andbelow 75%) in each semester may be granted by a committee appointed for this purpose,aftergettingsatisfied thattheabsence is dueto genuine reasons.

Shortageofattendancebelow65%inaggregateshallnot becondoned.

Astudentwhohasshortageofattendanceinasemestermayseekreadmissionintothecourse when offerednext.

Afeestipulatedbythecollegeshallbepaidalongwiththeapplicationforthecondonationof shortage of attendance.

Studentswhoseshortageofattendanceisnotcondonedinanysemesterarenoteligibletotake their endexaminationsand theregistrationshallstandcancelled.

6. DISTRIBUTIONANDWEIGHTAGEOF MARKS

Theperformanceofastudentineachsemestershallbeevaluatedsubject-wisewithamaximumof100marks.40marksforinternalevaluationand60marksfortheendexaminatio n have been earmarked.The Project Work shall be evaluated for 200 marks.Theminiproject/Term Paper/Seminar hasa weightageof50 marksandevaluatedinternally.

Depending upon the nature of the subject, the distribution and weightages for internal andexternalassessmentareasdetailedbelow:

TheorySubjects

i. Internalassessment: 40marks

a) FortheMidexaminationsthereshallbetwotests,oneconductedinthemiddleand the other at the end of each semester. The duration of each test is two hours.The question paper contains **Part-A** and **Part-B**. Part-A consists of three questions.Out of three questions two questions carry seven marks and one question carry sixmarks. Part-B consists of twenty objective type questions each carry half mark.Answering allquestionsiscompulsory.

b) Students shall submit assignments at the end of each unit in the syllabus and themarksallottedfortheassignmentsis10.

c) The formula for finding the total marks of internal assessment (40 marks) = 0.80 xhigher marks scored between the two internal tests+ 0.20 x marks scored in theothertest+marksfortheassignments.

ii. Externalassessment:

a) Theendsemesterexaminationisof3hoursdurationandcontains**PartA**and PartB.**Itcoversallthetopicsinallthe6unitsandtheweightageis60marks.**

b) PartAconsistsof6shortquestionseachcarrying2marks(6x2=12marks).These6ques tionsarecompulsoryandcoverallthe6unitsinthesyllabus.

c) Part B consists of 6 essay type / numerical questions, One question is set fromeach unit in the syllabus.Some questions may have sub sections.The studenthastoanswer4outof6questions,eachquestionwithaweightageof12marks(4x12)=48marks.

LaboratoryCourses

i. Internalassessment :40marks

Thereshallbecontinuousevaluationduringthesemesterfor40marksasshownbelow:

Day-to-Day workand laboratoryrecord - 25marksOneint

ernal testatthe endofthesemester - 15marks

Total - 40Marks

ii. ExternalAssessment:

Attheendofthesemesteranexaminationfor3hoursdurationshallbeconductedfor60marksbytheconcernedteacherandanexternalexaminer.

Subjects such as Engineering Graphics, Engineering Drawing, Machine Drawing, Designand Drawing of R.C. Structures, Steel structures, Irrigation structures, Estimation cost andvaluation, BuildingPlanningandDrawingetc.

i. Internalassessment :40marks

a) Thereshallbecontinuous evaluation withaweightageof40 marksasshown below :

Day-to-Daywork - 20marks

b) Internaltests:

Thereshall betwointernaltestsOneinthemiddleofthesemester and the otherat the end.MarksforInternalTests=0.8 xhighermarksscoredbetweenthetwotests +0.2xmarksscoredintheothertest. - 20marks

Total - 40Marks

ii. Externalassessment:

Sameasfor theorysubjectsgivenin6.1.ii.

MiniProject/Term paper

There shall be aMiniProject/Termpaper in the IIIyearI / IIsemester.Ithasa weightageof50marksandevaluatedinternallyattheendofthesemester.

Project

Outofatotalof200marksfortheProjectwork,60marksshall beforInternalEvaluation and 140 marks for the End Semester Examination.The End SemesterExamination (Viva-voce) shall be conducted by the committee.The committee consistsof an external examiner, Head of the Department and Supervisor of the Project. TheEvaluation of project work shall be conducted at the end of the IV year.The InternalEvaluation shall be on the basis of two seminars given by each student on the topic ofhisprojectandevaluatedbyaninternalcommittee.

Seminar

For the Seminar, Each student has to be evaluated based on the presentation of any latesttopic with a report of 10-15 pages and a power point presentation of minimum 10 slides.The student shall collect the information on a specialized topic and prepare a technicalreport, showing his understanding of the topic, and submit to the department, which shallbeevaluatedbytheDepartmentalcommitteeconsistingofHeadoftheDepartment,seminar supervisor and a senior faculty member. The seminar report shall be evaluated for50marks.Thereshallbenoexternalexaminationforseminar.

7. MINIMUMACADEMICREQUIREMENTS

Thefollowingacademicrequirementshavetobesatisfiedinadditiontotheattendancerequirementsmentionedunderrule5.

A Student is deemed to have satisfied the minimum academic requirements if he has**earned the credits allotted to each theory / practical design / drawing subject bysecuring not less than 35% of marks in the end semester exam, and minimum 40% ofmarksinthesum totaloftheinternalmarksandendsemesterexaminationmarks.**

A Student is deemed to have satisfied the minimum academic requirements if he has**earned the credits allotted to each laboratory / project by securing not less than 40%of marks in the end semester exam, and minimum 50% of marks in the sum total oftheinternalmarksandendsemesterexaminationmarks.**

A student is deemedto have satisfied the minimum academic requirements if he hasearned the credits allotted to mini project/term paper and seminar by securing not less than50%ofMarks.

A student shall register and put in minimum attendance in all 180 credits and earn all 180credits.

8. COURSEPATTERN

Theentirecourseof studyisforfouracademic years,alltheyearsare onsemesterpattern.

A student eligible to appear for the end semester examination in a subject, but absent orfailed in the end semester examination, may write the examination in that subject whenconductednext.

When a student is detained due lack of credits / shortage of attendance, he may be re-admitted into the same semester / year in which he has been detained.However, theacademic regulations under which he was first admitted shall continue to be applicable tohim.

9. PROMOTIONTONEXTHIGHER CLASS

A Student shall be promoted from 1st year to II year if he fulfills the minimum attendancerequirement underrule5.

AStudentshallbepromotedfromIIyeartoIIIyear,ifhefulfillstheacademicrequirement of 50% of the credits upto II year II semester from all the examinations,whether or not the candidate takes the examinations and secures prescribed minimumattendancein II year IIsemester.

AstudentshallbepromotedfromIIIyeartoIVyearifhefulfillstheacademicrequirements of 50% of the credits upto III year II semester from all the examinations,whether or not the candidate takes the examinations and secures prescribed minimumattendancein III yearIIsemester.

10. CUMULATIVEGRADEPOINTAVERAGE(CGPA)

Theory/Design/Drawing(%)	Laboratory/MiniProject/Term Paper/Project/Seminar(%)	Letter Grade	Level	Grade Point
≥90	≥90	O	Outstanding	10
≥80to< 90	≥80to< 90	S	Excellent	9
≥70to< 80	≥70to< 80	A	VeryGood	8
≥60to< 70	≥60to< 70	B	Good	7
≥50to< 60	≥50to<60	C	Fair	6
≥40to< 50	--	D	Satisfactory	5
<40	<50	F	Fail	0
			Absent	0

Computationof SemesterGradePointAverage(SGPA)

ThefollowingprocedureistobeadaptedtocomputetheSemesterGradePointAverage.(SGPA)andCumulativeGradePointAverage(CGPA).

The SGPA is the ratio of sum of product of the number of credits with the grade points scoredby a student in all the courses taken by a student and the sum of the number of credits of allthecoursesundergonebyastudenti.e.

$$\mathbf{SGPA(Si)=}\sum(\text{CixGi})/\sum\text{Ci}$$

WhereCiisthenumberofcreditsoftheithcourseandGiisthegradepointscoredbythestudentintheithcourse.

Computationof CGPA

- The**CGPA**isalsocalculatedinthesamemannertakingintoaccountallthecoursesundergonebyastudentoverallthesemesterofaprogrammei.e.,

$$\mathbf{CGPA=}\sum(\text{CixSi})/\sum\text{Ci}$$

- WhereSiistheSGPAoftheithsemesterandCiisthetotalnumberofcreditsinthatsemester.
- TheSGPAandCGPAshallberoundedoffto2decimalpointsandreportedinthetranscripts.
- EquivalentPercentage =(CGPA–0.75)x10

11. AWARD OFCLASS

After a student has satisfied the requirements prescribed for the completion of the program andis eligible for the award of B.Tech Degree, he shall be placed in one of the following fourclasses.

ClassAwarded	CGPAto besecured	
FirstClasswithDistinction	≥7.75(WithoutanySupplementaryAppearance)	**From the CGPAsecuredfrom180credits**
FirstClass	≥6.75to<7.75	
SecondClass	≥5.75to<6.75	
PassClass	≥4.75to<5.75	

12. WITHHOLDINGOF RESULTS:

If the students has not paid the dues, if any, to the college or if any case of indiscipline ormalpracticeispendingagainsthim,theexaminationresultsofthestudentwillbewithheld.

13. TRANSITORYREGULATIONS:

ForRe-admittedCandidates:

i) A student who is following JNTUK curriculum and detained due to shortage ofattendance at the end of the first semester of first year shall join the autonomousbatchoffirstyearfirstsemester.Suchstudentsshallstudyallthecoursespr escribed for the batch in which the student joins and considered on par withregular candidates of Autonomous stream and will be governed by the autonomousregulations.

ii) A student who is following JNTUK curriculum, detained due to lack of credits orshortage of attendance at the end of the second semester of first year or at thesubsequentsemestersshalljoinwiththeautonomousbatchintheappropriateseme ster.Suchcandidates shall berequired to pass inall the courses intheProgramme prescribed by the Board of Studies concerned for that batch of studentsfromthat semester onwards to beeligible fortheaward ofdegree.

iii) However, exemption will be given in the courses of the semester(s) of the batchwhich he had passed earlier and substitute subjects will be offered in place of themasdecidedby the Board of Studies.

iv) Thestudenthastoclearallhisbacklogsubjectsuptopreviousssemesterbyappeari ng for the supplementary examinations conducted by JNTUK for the awardof degree. The total number of credits to be secured for the award of the degree willbe sum of the credits up to previous semester under JNTUK regulations and thecredits prescribed for the semester in which a candidate seeks readmission andsubsequent semesters under the autonomous stream. The class will be awardedbasedontheacademic performanceofastudentintheautonomouspattern.

v) In case the students who do not have option of acquiring required credits with theexisting courses offered as per the curriculum under autonomy, credit balance canbe achievedby clearing the additional courses offered. The additional courses thatareoffered can be of theory or laboratory courses.

Transfercandidates(fromnon-autonomouscollegeaffiliated toJNTUK):

i) A student who is following JNTUK curriculum, transferred from other college tothis college in second year first semester or subsequent semesters shall join with theautonomous batch in the appropriate semester. Such candidates shall be required topassinallthecoursesintheProgrammeprescribedbytheBoardofStudiesconcernedfo rthatbatchofstudentsfromthatsemesteronwardstobeeligiblefortheawardofdegree.

ii) However, exemption will be given in the courses of the semester(s) of the batchwhich he had passed earlier and substitute subjects are offered in their place asdecidedbytheBoardofStudies.

iii) Thestudenthas to clear all his backlog subjects up to previous semester byappearing for the supplementary examinations conducted by JNTUK for the

awardofdegree.Thetotalnumberofcreditstobesecuredfortheawardofthedegreewill

be the sum of the credits upto previous semester under JNTUK regulations and thecredits prescribed for the semester in which a candidate joined after transfer andsubsequent semestersunder the autonomous stream. The class will be awardedbasedontheacademic performanceofastudentintheautonomouspattern.

iv) In case the students who do not have option of acquiring required credits with theexisting courses offered as per the curriculum under autonomy, credit balance canbe achievedby clearing the additional courses offered. The additional courses thatareofferedcanbeoftheory orlaboratorycourses.

Transfercandidates(fromanautonomous collegeaffiliatedtoJNTUK):

i) A student who has secured the required credits upto previous semesters as per theregulationsofotherautonomousinstitutionsshallalsobepermittedtobetransferred tothiscollege.

ii) A student who is transferred from the other autonomous colleges to this college insecond year first semester or subsequent semesters shall join with the autonomousbatch in the appropriate semester.Such candidates shall be required to pass in allthecoursesintheProgrammeprescribedbytheBoardofStudiesconcernedforthatbatchofstudentsfrom thatsemesteronwardstobeeligiblefortheawardofdegree.

iii) However, exemption will be given in the courses of the semester(s) of the batchwhich he had passed earlier and substitute subjects are offered in their place asdecided by the Board of Studies. The total number of credits to be secured for theaward of the degree will be the sum of the credits upto previous semester as pertheregulationsofthecollegefromwhichheistransferredandthecreditsprescribedfor thesemesterinwhichacandidatejoinedaftertransferandsubsequent semesters under the autonomous stream.The class will be awardedbasedontheacademic performanceofastudentintheautonomouspattern.

iv) In case the students who do not have option of acquiring required credits with theexisting courses offered as per the curriculum under autonomy, credit balance canbe achievedby clearing the additional courses offered. The additional courses thatareoffered can be of theory or laboratory courses.

PRAGATIENGINEERINGCOLLEGE:SURAMPALEM
(Autonomous)

ACADEMICREGULATIONSFORB.TECHLATERALENTRYSCHEME(LES)

Applicablefor thestudents admitted into IIyear B.TechIsemesterfrom the Academicyear 2017-18.

1. AWARDOF B.TECH DEGREE

AStudentwillbedeclaredeligiblefortheawardofB.TechDegreeifhefulfillsthefollowingacademicregulations.

AStudentshallbedeclaredeligiblefortheawardoftheB.TechDegree,ifhepursues acourseof study fornot less than threeacademicyears and notmorethan six academicyears.

1.2Thecandidateshallregisterfor132 creditsand secureall the132credits.

2. Theattendanceregulations ofB.Tech(Regular)shallbeapplicable toB.Tech(LES) studentsaswell.

3 PROMOTIONRULES

A Student shall be promoted from II year to III year, if he fulfills the minimum attendancerequirementunder rule 5of B.Tech (Regular).

A student shall be promoted from III year to IV year if he fulfills the academic requirementsof 50% of the credits upto III year II semester from all the examinations, whether or not thecandidate takes the examinations and secures prescribed minimum attendance in III year IIsemester.

4. AWARDOF CLASS

Afterastudenthassatisfiedtherequirementsprescribedforthecompletionoftheprogramandiseligiblefort he awardofB.TechDegree, heshallbeplaced inoneofthefollowingfour classes.

ClassAwarded	CGPAtobesecured	
FirstClasswithDistinction	≥ 7.75(Without anySupplementaryAppearance)	**From the CGPAsecuredfrom132credits**
FirstClass	≥ 6.75 to <7.75	
SecondClass	≥ 5.75 to < 6.75	
PassClass	≥ 4.75 to < 5.75	

5. Alltheotherregulationsasapplicable to**B.Tech4-yeardegreecourse (Regular) willholdgoodforB.Tech (Lateral Entry Scheme) also.**

GENERAL:

i) Whenever thewords"he","him","his"secureintheregulations,theyinclude"she","her","hers".
ii) Theacademicrulesandregulations shouldbereadasawholefor thepurposeofinterpretation.
iii) Incaseofanydoubtorambiguityintheinterpretationof rules,the decisionofthePrincipalofthecollegeis final.
iv) Thecollegemaychangeoramendtheacademicrulesandregulationsorsyllabiatanytimeandthechange drules come into effect fromthedateof issueof such orders.

MALPRACTIESRULES

Therules laiddown in JNTUKR16regulationswill befollowedinto to.

PRAGATIENGINEERINGCOLLEGE:SURAMPALEM
(Autonomous)

Ragging

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	 6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	 1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	 2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	 5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	 10 Months		Rs. 50,000/-

LET US MAKE PRAGATI RAGGING FREE COLLEGE

PRAGATIENGINEERINGCOLLEGE:SURAMPALEM
(Autonomous)

Ragging

ABSOLUTELY
NO TO RAGGING

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1. **Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.**

2. **Ragging entails heavy fines and/or imprisonment.**

3. **Ragging invokes suspension and dismissal from the College.**

4. **Outsiders are prohibited from entering the College and Hostel without permission.**

5. **Girl students must be in their hostel rooms by 7.00 p.m.**

6. **All the students must carry their Identity Cards and show them when demanded**

7. **The Principal and the Wardens may visit the Hostels and inspect the rooms any time.**

LET US MAKE PRAGATI RAGGING FREE COLLEGE

IYear–ISemester

S.No.	Subject Code	Subjects	L	T	P	C
1	16BH1T01	English–I	4	--	--	3
2	16BH1T03	Mathematics-I	4	--	--	3
3	16BH1T11	EngineeringChemistry	4	--	--	3
4	16ME1T01	EngineeringMechanics	4	--	--	3
5	16CS1T01	ComputerProgrammingUsingC	4	--	--	3
6	16BH1T13	EnvironmentalStudies	4	--	--	3
7	16BH1L05	Engineering/AppliedChemistry Laboratory	--	--	3	2
8	16BH1L01	English-CommunicationSkills Lab -I	--	--	3	2
9	16CS1L10	C-ProgrammingLab	--	--	3	2
TotalCredits						**24**

IYear– IISemester

S.No	SubjectCode	Subjects	L	T	P	C
1	16BH2T02	English –II	4	--	--	3
2	16BH2T04	Mathematics–II(Mathematical	4	--	--	3
3	16BH2T06	Mathematics–III	4	--	--	3
4	16BH2T09	EngineeringPhysics	4	--	--	3
5	16EE2T03	BasicElectricalandElectronicsEngineering	4	--	--	3
6	16ME2T02	EngineeringDrawing	2	--	3	3
7	16BH2L02	English-CommunicationSkills Lab-II	--	--	3	2
8	16BH2L03	Engineering/AppliedPhysicsLab	--	--	3	2
9	16BH2L04	Engineering/AppliedPhysics–VirtualLabs-Assignments	--	--	2	--
10	16ME2L01	EngineeringWorkshop&ITWorkshop	--	--	3	2
TotalCredits						**24**

IIYear– ISemester

S.No.	SubjectCode	Subjects	L	T	P	C
1	16ME3T04	Metallurgy&MaterialsScience	4	--	--	3
2	16ME3T05	MechanicsofSolids	4	--	--	3
3	16ME3T06	Thermodynamics	4	--	--	3
4	16BH3T14	ManagerialEconomics&FinancialAnalysis	4	--	--	3
5	16ME3T07	FluidMechanics&HydraulicMachines	4	--	--	3
6	16ME3T08	Computer AidedEngineeringDrawingPractice	3	3	--	3
7	16EE3L03	Electrical& ElectronicsEngineeringLab	--	--	3	2
8	16ME3L02	MechanicsofSolids&MetallurgyLab	--	--	3	2
TotalCredits						**22**

II Year– IISemester

S.No.	SubjectCode	Subjects	L	T	P	C
1	16ME4T10	KinematicsofMachinery	4	--	--	3
2	16ME4T11	ThermalEngineering -I	4	--	--	3
3	16ME4T12	ProductionTechnology	4	--	--	3
4	16ME4T13	Designof MachineMembers -I	4	--	--	3
5	16ME4T14	MachineDrawing	3	3	--	3
6	16ME4T15	IndustrialEngineeringandManagement	4	--	--	3
7	16ME4L04	FluidMechanics&HydraulicMachineryLab	--	--	3	2
8	16ME4L05	ProductionTechnologyLab	--	--	3	2
TotalCredits						**22**

IIIYear–ISemester

S.No.	SubjectCode	Subjects	L	T	P	C
1	16ME5T16	DynamicsofMachinery	4	--	--	3
2	16ME5T17	MetalCutting&MachineTools	4	--	--	3
3	16ME5T18	Designof MachineMembers–II	4	--	--	3
4	16ME5T19	OperationsResearch	4	--	--	3
5	16ME5T20	ThermalEngineering-II	4	--	--	3
6	16ME5L06	Theoryof Machines Lab	--	--	3	2
7	16ME5L07	MachineToolsLab	--	--	3	2
8	16ME5L08	ThermalEngineeringLab	--	--	3	2
9	16BH5T16	IPR&Patents	--	2	--	--
10	16ME5M01	MOOCS	--	3	--	--
TotalCredits						**21**

III Year–IISemester

S.No.	SubjectCode	Subjects	L	T	P	C
1	16ME6T21	Metrology	4	--	--	3
2	16ME6T22	Instrumentation&ControlSystems	4	--	--	3
3	16ME6T23	Refrigeration&Air-conditioning	4	--	--	3
4	16ME6T24	HeatTransfer	4	--	--	3
5	**OPENELECTIVE**					
	16BH6E01	1.Entrepreneurship	4	--	--	3
	16CS6E04	2.DataBaseManagementSystem				
	16CE6E01	3.WasteWaterManagement				
	16CS6E05	4.ComputerGraphics				
	16ME6E01	5.Robotics				
	16CE6E04	6.GreenEngineeringSystems				
6	16ME6L09	HeatTransferLab	--	--	3	2
7	16ME6L10	Metrology&InstrumentationLab	--	--	3	2
8	16ME6P01	Miniproject/Termpaper	--	--	3	2
9	16BH6T17	ProfessionalEthics& HumanValues	--	3	--	--
TotalCredits						**21**

IV Year–ISemester

S.No.	SubjectCode	Subjects	L	T	P	C
1	16ME7T25	Mechatronics	4	--	--	3
2	16ME7T26	CAD/CAM	4	--	--	3
3	16ME7T27	FiniteElementMethods	4	--	--	3
4	16ME7T28	PowerPlantEngineering	4	--	--	3
5	**ElectiveI**					
	16ME7D01	1.ComputationalFluidDynamics	4	--	--	3
	16ME7D02	2.ConditionMonitoring				
	16ME7D03	3.Additive Manufacturing				
6	**ElectiveII**					
	16ME7D04	1.AdvancedMaterials	4	--	--	3
	16ME7D05	2.DesignforManufacture				
	16ME7D06	3.GasDynamics &Jet Propulsion				
7	16ME7L11	CAD/CFDLab	--	--	3	2
8	16ME7L12	CAM/MechatronicsLab	--	--	3	2
TotalCredits						**22**

IVYear– IISemester

S.No.	SubjectCode	Subjects	L	T	P	C
1	16ME8T29	ProductionPlanningandControl	4	--	--	3
2	16ME8T30	UnconventionalMachiningProcesses	4	--	--	3
3	16ME8T31	AutomobileEngineering	4	--	--	3
4	**ElectiveIII**					
	16ME8D08	1.Thermal Equipment Design	4	--	--	3
	16ME8D09	2.NonDestructiveEvaluation				
	16ME8D10	3.QualityandReliabilityEngineering				
5	16ME8S01	Seminar	--	3	--	2
6	16ME8P02	ProjectWork	--	--	--	10
TotalCredits						**24**

I Year I Semester

ENGLISH-I

Course Category	HSMC	**Course Code**	16BH1T01
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	English Lab with Software's	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To enable the students to study and comprehend the prescribed lessons and subjects more effectively relating to their theoretical and practical components.
2.	To develop the communication skills of the students in both formal and informal situations.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Acquire knowledge in different fields besides the acquisition of Reading and Writing skills to apply in their real-life situations.	Applying
CO2	Learn about transport and road safety methods to make use of them in that phenomenon and extends their reading and writing skills.	Understanding
CO3	Create awareness on importance of mass production in the survival of mankind and strengthens them in reading and writing aspects.	Understanding
CO4	Identify the required sources of energy for rural India and practice their reading and writing skills.	Analyzing
CO5	Create awareness on ecological system and supports the learners in improving reading and writing skills.	Creating
CO6	Prepareto have an industrial etiquette and training and promotes their reading and writing skills.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	-	-	-	-	-	-	2	-	-	3	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO6	-	-	-	-	-	-	-	2	-	2	-	-	-	-

COURSE CONTENT	
UNIT I	'Human Resources' from English for Engineers and Technologists. 'An Ideal Family' from Panorama: A Course on Reading
UNIT II	' Transport: Problems and Solutions' from English for Engineers and Technologists. 'War' from 'Panorama : A Course on Reading'
UNIT III	'Evaluating Technology' from English for Engineers and Technologists. 'The Verger' from 'Panorama : A Course on Reading' THE COP AND THE ANTHEM BY O.HENRY
UNIT IV	'Alternative Sources of Energy' from English for Engineers and Technologists. ' The Scarecrow' from Panorama : A Course on Reading
UNIT V	'Our Living Environment' from English for Engineers and Technologists. 'A Village Host to Nation' from Panorama : A Course on Reading
UNIT VI	' Safety and Training' from English for Engineers and Technologists. 'Martin Luther King and Africa' from Panorama : A Course on Reading

TEXT BOOKS	
1.	English for engineers and technologists, published BY orient BLACKSWAN PVT LTD
2.	The cop and the anthem by O. Henry published by perfection learning
REFERENCE BOOKS	
1.	PANORAMA: A COURSE ON READING, Published by Oxford University Press India

I Year I Semester

MATHEMATICS-I

Course Category	BSC	**Course Code**	16BH1T03
Course Type	Problematic	**L-T-P-C**	4-0-0-3
Prerequisites	Concept of matrices and differentiation.	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2.	The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Solve the linear system of equations by using different methods.	Applying
CO2	Find the Eigen values and Eigen vectors and also finding inverse and power of a matrix by using Cayley - Hamilton theorem.	Applying
CO3	Find rank, index, signature and nature of a Quadratic form.	Applying
CO4	Solve first order differential equations and able to apply physical problems.	Applying
CO5	Solve higher order linear differential equations with constant coefficients.	Analyzing
CO6	Find partial derivative of different orders, maxima, minima of a function of two variables, three variables and functional dependence.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	2	-	-
CO6	3	3	2	-	-	-	-	-	-	-	-	2	-	-

COURSE CONTENT	
UNIT I	Rank-Echelon Form-Normal form – Solution of linear systems – Gauss elimination - Gauss Jordon- Gauss Jacobi and Gauss Seidel methods. **Applications:** Finding the current in electrical circuits.
UNIT II	Eigen values - Eigen vectors– Properties – Cayley-Hamilton theorem - Inverse and powers of a matrix by using Cayley-Hamilton theorem- Diagonalization. **Applications:** Free vibration of a two-mass system.
UNIT III	Quadratic forms Reduction of quadratic form to canonical form – Rank - Positive, negative and semi definite- Index – Signature.
UNIT IV	Linear-Bernoulli-Exact-Reducible to exact. **Applications:** Newton's Law of cooling-Law of natural growth and decay-Orthogonal trajectories- Electrical circuits- Chemical reactions.
UNIT V	Non-homogeneous equations of higher order with constant coefficients with RHS term of the typee^{ax}, $sin\,ax, cos\,ax$, polynomials in x, $e^{ax}V(x)$, $xV(x)$ – Method of Variation of parameters. **Applications:** LCR circuit, Simple Harmonic motion.
UNIT VI	Introduction- Homogeneous function-Euler's theorem-Total Derivative-Chain rule Generalized Mean value theorem for single variable (without proof)-Taylor's and Mc Laurent's series expansion of functions of two variables - Jacobian– Functional dependence. **Applications:** Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

TEXT BOOKS	
1.	B.S.Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2.	N.P.Bali, Engineering Mathematics, Lakshmi Publications.
3.	Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
REFERENCE BOOKS	
1.	Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn.
2.	Dean G. Duffy, Advanced engineering mathematics with MATLAB, CRC Press.
3.	Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
4.	Srimanta Pal, SubodhC.Bhunia, Engineering Mathematics, Oxford UniversityPress.
5.	Dass H.K., RajnishVerma. Er, Higher Engineering Mathematics, S. Chand Co.Pvt. Ltd, Delhi.

I Year I Semester

ENGINEERING CHEMISTRY

Course Category	BSC	**Course Code**	16BH1T11
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Plastics are nowadays used in household appliances; They are also used as composites (FRP) in aerospace and automotive industries.
2.	Fuels as a source of energy are a basic need of any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence are introduced to create awareness on the topics.
3.	The basics for the construction of galvanic cells are introduced to have understanding on the concepts. Understanding on the concept of Corrosion and Mechanism of Corrosion with Theories like Electrochemical theory.
4.	With the increase in demand, a wide variety of materials are coming up; some of them have excellent engineering properties and a few of these materials
5.	Water is necessary in almost all the industries, more so where steam is generated and also where it is supplied for drinking purposes. Problems associated with Water quality Methods to be used to Control or remove the Hardness.
6.	Materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries are introduced with a Special emphasis on Refractories, Lubricants, Cement, Insulators, Bio materials and fuel cells.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Have an understanding on the plastic materials and their suitable design for engineering applications.	Applying
CO2	Learn about various fuels and their calorific values for use in various industrial applications.	Analyzing
CO3	Create awareness on corrosion and its impacts and the causes and control of corrosion.	Creating
CO4	Create knowledge on nano materials, liquid crystals and super conductors and their applications to learn green chemistry and to identify the green technologies to be implemented in industry.	Understanding
CO5	Learn the technology to beused in purifying the water and waste water.	Applying
CO6	Create knowledge and advanced techniques in the manufacture of cement, refractories, lubricants and their applications.	Understanding

Contribution of Course Outcomes towards achievement of Program														
Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	2	-	-	-	-	-	1	2
CO2	2	-	-	-	-	-	3	-	-	-	-	-	3	3
CO3	3	-	-	-	-	-	2	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	3	-	-	-	-	1	3	2
CO5	2	-	-	-	-	-	3	-	-	-	-	2	-	2
CO6	3	-	-	-	-	-	2	-	-	-	-	2	2	2

COURSE CONTENT	
UNIT I	**HIGH POLYMERS AND PLASTICS:** Polymerisation:- Definition- Types of Polymers - Mechanism of polymerization- Stereo regular polymers- Methods of polymerization(emulsion and suspension)-Physical and Mechanical properties. Plastics as engineering materials: advantages and limitations- Thermoplastics and Thermosetting plastics Compounding and fabrication (Compression, Injection, Extrusion and Blown Techniques)- Preparation, properties and applications of polyethene, PVC, Bakelite Teflon, Poly methyl Methacrylate (PMMA) and polycarbonates Elastomers: - Natural rubber- Disadvantages- Mastication - compounding and vulcanization - Synthetic rubbers: Buna S, Buna N, Thiokol and polyurethanes - Applications of elastomers. Composite materials & Fiber reinforced plastics - Biodegradable polymers - Conducting polymers.
UNIT II	**FUEL TECHNOLOGY:** Fuels – Definition –Classification - Characteristics of a good fuel - Calorific value - HCV and LCV-Dulong's formula - Bomb calorimeter – Numerical problems - Coal -- Proximate and Ultimate analysis and their Significance - Liquid fuels - Petroleum- Origin and Refining - Cracking - Synthetic petrol -Petrol knocking - Diesel knocking - Octane and Cetane ratings - Anti-knock agents - Power alcohol – Bio diesel, Gaseous fuels:- Natural gas, LPG and CNG, Combustion - Calculation of air for the combustion of a fuel, Flue gas analysis – Orsat's apparatus - Numerical problems on combustion Explosives:- Rocket fuels
UNIT III	**ELECTROCHEMICAL CELLS AND CORROSION:** Galvanic cells - Reversible and irreversible cells - Single electrode potential - Electro chemical series and uses of this series- Standard electrodes (Hydrogen, Calomel and Glass electrode) - Concentration Cells - Batteries: Dry Cell - Ni-Cd cells - Ni-Metal hydride cells - Li cells - Zinc - air cells. Fuel cells: - Hydrogen Oxygen fuel cells - Methanol Oxygen fuel cells Corrosion :- Definition - Theories of Corrosion (chemical & electrochemical) – Formation corrosion - Passivity of metals -Pitting corrosion – Corrosion under insulation - Galvanic series - Factors which influence the rate of corrosion –Protection from corrosion - Design and material selection - Cathodic protection - Protective coatings: - Surface preparation - Metallic (galvanizing and tinning) coatings - Methods of application on metals (Electroplating, Electroless plating). of galvanic cells by different metals, by concentration cells, by differential aeration and waterlin

UNIT IV	**CHEMISTRY OF ADVANCED MATERIALS:** Nano materials:- Introduction - Sol-gel method & chemical reduction method of preparation- Characterization by Braunear Emmett Teller(BET) method, Transmission Electron Microscope (TEM) and Scanning Electron Microscope (SEM) methods - Carbon nano tubes : Types, preparation(Laser ablation, Chemical vapour deposition methods), properties and applications, Fullerenes. Liquid crystals:- Introduction - Types - Applications Super conductors:-Type -I, Type II - Characteristics and applications Green synthesis:- Principles of Green Chemistry - Methods of synthesis (Aqueous Phase Method, Super Critical Fluid Extraction and Phase Transfer Catalysis) with examples - R4M4 principles
UNIT V	**WATER TECHNOLOGY:** Hard water:- Reasons for hardness - units of hardness - determination of hardness and alkalinity - Water for steam generation - Boiler troubles - Priming and Foaming, Scale formation, Boiler corrosion, Caustic embrittlement - Internal treatments - Softening of Hard water : Lime - Soda process, Zeolite process and numerical problems based on these processes and Ion Exchange process - Water for drinking purposes Purification - Sterilization and disinfection : Chlorination, Break point chlorination and other methods - Reverse Osmosis and Electro Dialysis.
UNIT VI	**CHEMISTRY OF ENGINEERING MATERIALS:** Refractories: - Definition, classification, characteristics (Thermal conductivity, Porosity, Refractoriness, Refractoriness under load) and failures Lubricants: - Definition, function, Types of lubricants, properties (Definition and importance) Cement: - Constituents, manufacturing, hardening and setting, decay of concrete.Bio Materials:- Definition – Characteristics- Applications Insulators: - Thermal and electrical insulators

TEXT BOOKS	
1.	Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co.
2.	Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2015 edition.
REFERENCE BOOKS	
1.	Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others, 2014 edition (second).
2.	Engineering Chemistry by Prasanth Rath, Cengage Learning, 2015 edition.
3.	A text book of engineering Chemistry by S. S. Dara; S. Chand & Co Ltd., Latest Edition
4.	Applied Chemistry by H.D. Gesser, Springer Publishers
5.	Text book of Nano-science and nanotechnology by B.S. Murthy,P. Shankar and others, University Press, IIM

I Year I Semester

ENGINEERING MECHANICS

Course Category	ESC	**Course Code**	16ME1T01
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The students are to be exposed to the concepts of force and friction, direction and its application.
2.	The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.
3.	The students are to be exposed to concepts of center of gravity.
4.	The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.
5.	The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.
6.	The students are to be exposed to concepts of work, energy and particle motion

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Demonstrate the forces and friction applications.	Understanding
CO2	Analyze the Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, and Spatial Systems.	Analyzing
CO3	Apply the concept of Centroid and Center of gravity for Composite Figures.	Applying
CO4	Analyze the Area moments of Inertia and Mass Moment of Inertia of Composite Figures.	Analyzing
CO5	Analyze the paths of velocity and acceleration computation.	Analyzing
CO6	Apply the concepts of work, energy and particle motion for engineering applications.	Applying

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	1	-	-	-	-	-	-	-	-	2	1
CO2	3	3	3	2	-	-	-	-	-	-	-	-	2	1
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	1
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	1
CO5	2	1	1	2	-	-	-	-	-	-	-	-	2	1

CO6	2	2	2	-	-	-	-	-	-	-	-	-	2	1

COURSE CONTENT	
UNIT I	Introduction to Engg. Mechanics – Basic Concepts. Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems. Friction: Introduction, limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction, Problems on wedges.
UNIT II	Equilibrium of Systems of Forces: Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, Spatial Systems for concurrent forces. Lamis Theorem, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium, analysis of plane trusses.
UNIT III	Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures Centre of Gravity: Centre of gravity of simple body (from basic principles), center of gravity of composite bodies, Pappus theorems.
UNIT IV	Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.
UNIT V	Kinematics: Rectilinear and Curvilinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion. Kinetics: Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies, Principle of virtual work.
UNIT VI	Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method., Law of conservation of momentum

TEXT BOOKS	
1.	Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hill publications.
2.	Engg. Mechanics - S. S. Bhavikatti, New Age International.
REFERENCE BOOKS	
1.	Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11th Edn – Pearson Publ.
2.	Engineering Mechanics, statics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
3.	Engineering Mechanics, statics and dynamics – I.H.Shames, – Pearson Publ.
4.	Mechanics For Engineers, statics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/122104015/
2.	https://www.youtube.com/watch?v=LG0YzGeAFxk

I Year I Semester

COMPUTER PROGRAMMING USING C

Course Category	ESC	**Course Code**	16CS1T01
Course Type	Theory & programming language	**L-T-P-C**	4-0-0-3
Prerequisites	Computer lab with c-language	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES: Formulating algorithmic solutions to problems and implementing algorithms in C.	
1.	Notion of Operation of a CPU, Notion of an algorithm and computational procedure, editing and executing programs in Linux.
2.	Understanding branching, iteration and data representation using arrays.
3.	Modular programming and recursive solution formulation.
4.	Understanding pointers and dynamic memory allocation.
5.	Understanding miscellaneous aspects of C.
6.	Comprehension of file operations.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Understand the fundamentals of Computers, Procedural and Object-oriented languages, and development of algorithms.	Understanding
CO2	Use different data types, learn programming styles, and assignment variations in a C program.	Applying
CO3	Choose the loops and decision-making statements to solve the problem.	Applying
CO4	Demonstrate the use of functions to solve the given problem.	Understanding
CO5	Implement different operations on arrays and use string functions.	Applying
CO6	Understand pointers, structures and unions and also implement file operations in C programming for a given application.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	-	-	-	-	-	1	-	1	1
CO2	3	3	3	3	-	-	-	-	-	-	-	-	1	1
CO3	3	3	3	2	-	-	-	-	-	-	-	-	2	1
CO4	3	3	3	3	-	-	-	-	-	-	-	-	2	2

CO5	3	3	3	3	-	-	-	-	-	-	-	-	2	2
CO6	3	3	3	2	-	-	-	-	-	-	-	-	2	2

COURSE CONTENT	
UNIT I	History and Hardware - Computer Hardware, Bits and Bytes, Components, Programming Languages - Machine Language, Assembly Language, Low- and High-Level Languages, Procedural and Object-Oriented Languages, Application and System Software, The Development of C Algorithms the Software Development Process.
UNIT II	Introduction to C Programming- Identifiers, The main () Function, The printf () Function Programming Style - Indentation, Comments, Data Types, Arithmetic Operations, Expression Types, Variables and Declarations, Negation, Operator Precedence and Associativity, Declaration Statements, Initialization. Assignment - Implicit Type Conversions, Explicit Type Conversions (Casts), Assignment Variations, Mathematical Library Functions, Interactive Input, Formatted Output, Format Modifiers.
UNIT III	Control Flow-Relational Expressions - Logical Operators: Selection: if-else Statement, nested if, examples, Multi-way selection: switch, else-if, examples. Repetition: Basic Loop Structures, Pretest and Posttest Loops, Counter-Controlled and Condition- Controlled Loops, while Statement, for Statement, Nested Loops, do-while Statement.
UNIT IV	Modular Programming: Function and Parameter Declarations, returning a Value, Functions with Empty Parameter Lists, Variable Scope, Variable Storage Class, Local Variable Storage Classes, Global Variable Storage Classes, Pass by Reference, Passing Addresses to a Function, Storing Addresses, Using Addresses, Declaring and Using Pointers, Passing Addresses to a Function. Case Study: Swapping Values, Recursion - Mathematical Recursion, Recursion versus Iteration.
UNIT V	Arrays & Strings Arrays: One-Dimensional Arrays, Input and Output of Array Values, Array Initialization, Arrays as Function Arguments, Two-Dimensional Arrays, Larger Dimensional Arrays- Matrices. Strings: String Fundamentals, String Input and Output, String Processing, Library Functions
UNIT VI	Pointers, Structures, Files Pointers: Concept of a Pointer, Initialization of pointer variables, pointers as function arguments, passing by address, Dangling memory, address arithmetic, character pointers and functions, pointers to pointers, Dynamic memory management functions, command line arguments. Structures: Derived types, Structures declaration, Initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, bit-fields. Data Files: Declaring, Opening, and Closing File Streams, reading from and Writing to Text Files, Random File Access

TEXT BOOKS	
1.	ANSI C Programming, Gary J. Bronson, Cengage Learning.
2.	Programming in C, B. L.Juneja, Anita Seth, Cengage Delmar Learning India Pvt.
3.	The C programming Language, Dennis Richie and Brian Kernighan, Pearson Education.
REFERENCE BOOKS	
1.	C Programming-A Problem Solving Approach, Forouzan, Gilberg, Cengage.
2.	Programming with C, R S Bichkar, University Press, 2012.
3.	Programming in C, ReemaThareja, Oxford.
4.	C by Example, Noel Kalicharan, Cambridge University Press.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/106104128/
2.	http://students.iitk.ac.in/programmingclub/course/#notes
3.	http://c-faq.com/~scs/cclass/cclass.html
4.	http://www.youtube.com/watch?v=b00HsZvg-V0&feature=relmfu
5.	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-087-practical-programming-in-c-january-iap-2010/

I Year I Semester

ENVIRONMENTAL STUDIES

Course Category	HSMC	**Course Code**	16BH1T13
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Basic understanding of the environment, global problems and ecosystems.
2.	Overall understanding of the natural resources
3.	Basic understanding of Biodiversity.
4.	Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities
5.	Awareness on the social issues, environmental legislation and global treaties
6.	An understanding of the environmental impact of developmental activities

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Create awareness on Global environmental problems including the eco system and its protection and the challenges.	Creating
CO2	Learn the importance of natural resources and their conservation for sustenance.	Remembering
CO3	Identify the threats to biodiversity and its conservation for different strategies.	Applying
CO4	Focus on the origins, pathways and consequences of anthropogenic activities in the environment as well as the approaches to control pollution and its remediation.	Remembering
CO5	Understand the important environmental problems and environmental legislation for sustainable development.	Understanding
CO6	Apply Environmental Management System (EMS) to an industry for sustenance.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	1	2	1	-	-	-	-	-	-
CO2	-	-	-	-	-	-	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	2	2	-	-	-	-	-	-

CO4	-	-	-	-	-	1	2	2	-	-	-	1	-	-
CO5	-	-	-	-	-	3	1	2	-	-	-	-	-	-
CO6	-	-	-	-	-	2	2	1	-	2	-	-	-	-

COURSE CONTENT	
UNIT I	**Multidisciplinary nature of Environment and Ecology:** Definition, Scope and Importance, *Introduction to Brief works of noted Environmentalists & Naturalists*(*Wangari Mathai,Salim Ali and Sunderlal Bahuguna)* ,Sustainability: Stockholm and Rio Summit– Global Environmental Challenges: Global warming and climate change, Carbon Credits, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information Technology in Environment and human health. Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. Classification of ecosystems-characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems: Estuaries and Mangroves
UNIT II	**Natural Resources:** Natural resources and associated problems Forest resources – Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, Sustainable mining of Granite, Laterite, Coal, Sea and River sands. **Food resources:** World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity **Energy resources:** Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources Vs Oil and Natural Gas Extraction. **Land resources:** Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.
UNIT III	**Biodiversity and its conservation:** Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts - Endangered and endemic species of India – Conservation of biodiversity.
UNIT IV	**Environmental Pollution:** Definition, Cause, effects and control measures of Air pollution, Water pollution, *Heavy Metal pollution*, Soil pollution, Noise pollution, Radioactive pollution: Sources and risks. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Style, Impact of Fire Crackers on Man and his wellbeing. **Solid Waste Management:** Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e - waste management.
UNIT V	**Social Issues and the Environment:** Urban problems related to energy -Water conservation- *Coastal Regulatory zone management,* rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.
UNIT VI	**Environmental Management**: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. *Environmental Modeling: Definition (Box*

	Model and Gaussian Plume Modeling), Ecotourism, Green Campus – Green business, Green politics *and Green Building.* The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a PPT.

TEXT BOOKS	
1.	Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2.	Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3.	Environmental Studies, P.N. Palanisamy, P. Manikandan, A. Geetha, and K.Manjula Rani; Pearson
REFERENCE BOOKS	
1.	Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2.	A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3.	Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4.	Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014
5.	Environmental pollution, Monitoring and Control by Khopkar.S.M, New Age Publishers.
6.	A Text Book of Fundamentals of Ecology, E.P.Odam, Philadelphia: W.B. Saunders Company.

I Year I Semester

ENGINEERING/APPLIED CHEMISTRY LAB

Course Category	BSC	**Course Code**	16BH1L05
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites		**Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

By the end of the Course, the Student will be able to:

CO	Description	Blooms Taxonomy Level
CO1	Create knowledge on differentiating hard and soft water, solve the related numerical problems on water purification and its significance in industry and daily life.	Evaluating
CO2	Have the knowledge in carrying out different types of titrations for estimation of concerned in materials comparatively more quantities of materials involved for good results.	Understanding
CO3	Have the knowledge in handling different types of instruments for analysis of materials using small quantities of materials involved for quick and accurate results.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3	-	-	-	-	-	-	2	-	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	1
CO3	2	2	-	1	-	-	1	-	-	-	-	-	-	-

LIST OF EXPERIMENTS:	
1.	Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc.,
2.	Trial experiment – Estimation of HCI using standard Na2co2 solutions
3.	Estimation of KMnO4 using standard Oxalic acid solution.
4.	Estimation of Ferric iron using standard K2Cr2O7 solution
5.	Estimation of Copper using standard K2Cr2O7 solution.
6.	Estimation of Total Hardness water using standard EDTA solution.
7.	Estimation of Copper using standard EDTA solution.
8.	Estimation of Copper using Colorimeter
9.	Estimation of pH of the given sample solution using pH meter.
10.	Conductometric Titrations between strong acid and strong base
11.	Conductometric Titrations between strong acid and Weak base
12.	Potentiometric Titrations between strong acid and strong base
13.	Potentiometric Titrations between strong acid and Weak base
14.	Estimatinog of Zinc using standard potassium ferrocyanide solution
15.	Estimation of Vitamin – C

TEXT BOOKS	
1.	Dr.Jyotsna Cherukuis(2012)Laboratory Manual of Engineering Chemistry-II, VGS Techno Series
2.	Chemistry Practical Manual, Lorven Publications
3.	K. Mukkanti (2009) Practical Engineering Chemistry, B.S. Publication

I Year - I Semester

ENGLISH - COMMUNICATION SKILLS LAB- I

Course Category	HSMC	**Course Code**	16BH1L01
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	-	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVE	
1.	To enable the students to learn through practice the communication skills of listening, speaking, reading and writing.

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Distinguish spoken language & use it appropriately with clarity and confidence by choosing the right expressions according to social and professional contexts.	Analyzing
CO2	Interpret and responding appropriately in various day to day contexts and to demonstrate the need of learning speech sounds.	Evaluating
CO3	Identify the sounds of English and improve their pronunciation and to utilize the stress and intonation in their pronunciation according to the context which in turn reduces the mother tongue influence.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	-	-	-

COURSE CONTENT	
UNIT I	WHY study Spoken English? Making Inquiries on the phone, thanking and responding to Thanks -- Practice work.
UNIT II	Responding to Requests and asking for Directions -- Practice work.
UNIT III	Asking for Clarifications, Inviting, Expressing Sympathy, Congratulating Apologizing, Advising, Suggesting, Agreeing and Disagreeing -- Practice work.
UNIT IV	Letters and Sounds -- Practice work.
UNIT V	The Sounds of English -- Practice work.
UNIT VI	Pronunciation Stress and Intonation -- Practice work

TEXT BOOKS	
1.	Strengthen your communication skills by Dr M Hari Prasad, Dr Salivendra Raju and Dr G Suvarna Lakshmi, Maruti Publications.

2.	English for Professionals by Prof Eliah, B.S Publications, Hyderabad.
3.	Unlock, Listening and speaking skills 2, Cambridge University Press
4.	Spring Board to Success, Orient BlackSwan
5.	A Practical Course in effective english speaking skills, PHI
6.	Word power made handy, Dr shalini verma, Schand Company

I Year - I Semester

C-PROGRAMMING LAB

Course Category	ESC	**Course Code**	16CS1L10
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures a File programming.
2.	Acquire knowledge about the basic concept of writing a program.
3.	Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.
4.	Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.
5.	Role of Functions involving the idea of modularity.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO 1	Develop conditional and iterative statements.	Applying
CO 2	Design programs with homogeneous sequences and code reusability features.	Creating
CO 3	Implement programs with heterogeneous sequences, static & dynamic memory management and file handling.	Applying

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**

CO1	3	3	3	3	-	-	-	-	-	-	-	-	2	2
CO2	3	3	3	3	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	-	2	2

COURSE CONTENT	
Exercise -1	**Basics** 1.What is an OS Command, Familiarization of Editors - vi, Emacs 2.Using commands like mkdir, ls, cp, mv, cat, pwd, and man 3.Write a C Program to perform Adding, Subtraction, Multiplication and Division of two numbers from Command line
Exercise -2	**Basic Math** 1. Write a C Program to Simulate 3 Laws at Motion 2. Write a C Program to convert Celsius to Fahrenheit and vice versa
Exercise -3	**Control Flow - I** 1. Write a C Program to Find Whether the Given Year is a Leap Year or not. 2. Write a C Program to Add Digits & Multiplication of a number
Exercise -4	**Control Flow - II** 1. Write a C Program to Find Whether the Given Number is i. Prime Number ii. Armstrong Number 2. Write a C program to print Floyd Triangle 3. Write a C Program to print Pascal Triangle
Exercise -5	**Functions** 1. Write a C Program demonstrating of parameter passing in Functions and returning values. 2. Write a C Program illustrating Fibonacci, Factorial with Recursion without Recursion
Exercise -6	**Control Flow - III** 1. Write a C Program to make a simple Calculator to Add, Subtract, Multiply or Divide Using switch…case 2. Write a C Program to convert decimal to binary and hex (using switch call function the function)
Exercise -7	**Functions - Continued** 1. Write a C Program to compute the values ofsin x and cos x and e^x values using Series expansion. (use factorial function)
Exercise -8	**Arrays:** **Demonstration of arrays:** 1. Search-Linear. 2. Sorting-Bubble, Selection. 3. Operations on Matrix.
Exercise -9	**Structures:** 1. Write a C Program to Store Information of a Movie Using Structure 2. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation 3. Write a C Program to Add Two Complex Numbers by Passing Structure to a Function

Exercise -10	**Arrays and Pointers:** 1. Write a C Program to Access Elements of an Array Using Pointer 2. Write a C Program to find the sum of numbers with arrays and pointers.
Exercise -11	**Dynamic Memory Allocations:** 1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function. 2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function. Understand the difference between the above two programs.
Exercise -12	**Strings:** a) Implementation of string manipulation operations with library function. i) copy ii) concatenate iii) length iv) compare b) Implementation of string manipulation operations without library function. i) copy ii) concatenate iii) length iv) compare
Exercise -13	**Files:** a) Write a C programming code to open a file and to print it contents on screen. b) Write a C program to copy files
Exercise -14	**Files Continue:** 1. Write a C program merges two files and stores their contents in another file. 2. Write a C program to delete a file.

Note:

1. **All the Programs must be executed in the Linux Environment. (Mandatory)**
2. **The Lab record must be a print of the LATEX (.tex) Format.**

I year - II semester

ENGLISH-II

Course Category	HSMC	**Course Code**	16BH2T02
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To improve the language proficiency of the students in English with emphasis on LSRW skills.
2.	To enable the students to study and comprehend the prescribed lessons and subjects more effectively relating to their theoretical and practical components.
3.	To develop the communication skills of the students in both formal and informal situations.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Emphasize the ultimate aim of education is to enhance wisdom and inspires the readers to serve their nation with their self-enrichment.	Understanding
CO2	Promote peaceful co-existence and universal harmony in the society and empowers the learners to have initiation in innovation.	Understanding
CO3	Manage different cultural shock due to globalization and to develop multiculturalism to appreciate diverse cultures and also motivates the learners to contribute to their nation.	Analyzing

CO4	Project the needs of society to examine its outdated traditions and motivates the readers to strengthen their nation with their contribution to science and technology.	Analyzing
CO5	Outline the necessity to protect environment for the sustainability of the future generation and influences the readers to face challenges in the extensive services to the society.	Understanding
CO6	Inspire the advancement of software by the eminent personalities and motivates the readers to think and tap their innate talents.	Understanding

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	2	-	3	-	-	-	-
CO3	-	-	-	-	-	2	-	-	-	2	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO5	-	-	-	-	-	-	2	-	-	2	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	2	-	2	-	-

COURSE CONTENT

UNIT I	1. ' The Greatest Resource- Education' from English Encounters 2. ' A P J Abdul Kalam' from The Great Indian Scientists.
UNIT II	1. ' A Dilemma' from English Encounters 2. 'C V Raman' from The Great Indian Scientists
UNIT III	1. 'Cultural Shock': Adjustments to new Cultural Environments from English Encounters. 2. 'Homi Jehangir Bhabha' from The Great Indian Scientists 3. ’What can we learn from West?’ from A Better India, A Better World
UNIT IV	1. 'The Lottery' from English Encounters. 2. 'Jagadish Chandra Bose' from The Great Indian Scientists.

UNIT V	1. ' The Health Threats of Climate Change' from English Encounters. 2. ' Prafulla Chandra Ray' from The Great Indian Scientists.
UNIT VI	1. ' The Chief Software Architect' from English Encounters 2. ' Srinivasa Ramanujan' from The Great Indian Scientists.

I year - II semester

MATHEMATICS – II
(Mathematical Methods)

Course Category	BSC	**Course Code**	16BH2T04
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2.	The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Solve the algebraic and transcendental Equation by using numerical method.	Applying
CO2	Find the required functional volume using interpolation formulae with equal and unequal intervals.	Understanding
CO3	Evaluate the given integral using numerical methods by different formulae.	Applying
CO4	Express the given function into Fourier series in the given interval. Find range of sine and cosine series in the given interval.	Applying
CO5	Find the Fourier integral and transforms of a given function and Fourier sine and cosine transform of a given function.	Applying
CO6	Find the P.D.E. by elimination of arbitrary function and arbitrary constant. Solve the liner and non-liner PDEs.	Applying

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	1	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	1	-	-	-	-	-	-	-	-	2	-	-
CO6	3	3	2	-	-	-	-	-	-	-	-	2	-	-

COURSE CONTENT	
UNIT I	**<u>Solution of Algebraic and Transcendental Equations</u>** Introduction- Bisection method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations).
UNIT II	Introduction- Errors in polynomial interpolation – Finite differences- Forward differences- Backward differences –Central differences – Symbolic relations and separation of symbols - Differences of a polynomial-Newton's formulae for interpolation – Interpolation with unequal intervals - Lagrange's interpolation formula.
UNIT III	Numerical Integration and solution of Ordinary Differential equations Trapezoidal rule- Simpson's 1/3rd and 3/8th rule-Solution of ordinary differential equations by Taylor's series Picard's method of successive approximations-Euler's method - Runge-Kutta method (second and fourth order).
UNIT IV	Introduction- Periodic functions – Fourier series of -periodic function - Dirichlet's conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.
UNIT V	Fourier integral theorem (without proof) – Fourier sine and cosine integrals - sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.
UNIT VI	Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations. Classification of second order partial differential equations. Applications: Method of separation of Variables- Solution of One-dimensional Wave, Heat and two-dimensional Laplace equations.

TEXT BOOKS	
1.	**B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2.	**N.P.Bali**, Engineering Mathematics, Lakshmi Publications.
3.	**Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.

REFERENCE BOOKS	
1.	**Dean G. Duffy**, Advanced engineering mathematics with MATLAB, CRC Press
2.	**V.Ravindranath**and **P.Vijayalakshmi**, Mathematical Methods, Himalaya Publishing House.
3.	**David Kincaid, Ward Cheney**, Numerical Analysis-Mathematics of Scientific Computing, 3rd Edition, Universities Press.
4.	**Srimanta Pal, SubodhC.Bhunia**, Engineering Mathematics, Oxford University Press.
5.	**Dass H.K., RajnishVerma. Er.**, Higher Engineering Mathematics, S. Chand Co. Pvt. Ltd, Delhi.

I year - II semester

MATHEMATICS – III

Course Category	BSC	**Course Code**	16BH2T06
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2.	The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.
3.	Understand the most basic numerical methods to solve simultaneous linear equations.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Find the Laplace transform of functions and evaluation of integrals.	Understanding
CO2	Find the inverse Laplace transform of different functions and solve the differential equations using Laplace transform.	Applying
CO3	Trace the curve for the given equation evaluate the double and triple integrals by direct method change of order of integration and change of variables.	Applying
CO4	Evaluate the given integrals by using Beta and Gamma functions.	Applying
CO5	Find the gradient of a scalar filed, divergence and curl of vector filed and vector identities.	Understanding
CO6	Evaluate the line, surface and volume integrals. Solve the problems using vector integral theorems.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	2	-	-
CO6	3	3	3	-	-	-	-	-	-	-	-	2	-	-

COURSE CONTENT	
UNIT I	Laplace transforms Laplace transforms of standard functions-Shifting theorems - Transforms of derivatives and integrals – Unit step function –Dirac's delta function.
UNIT II	Inverse Laplace transforms Inverse Laplace transforms – Shifting Theorems - Transforms of derivatives and integrals - Convolution theorem (without proof). Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.
UNIT III	Multiple integrals Curve tracing: Cartesian, Polar and Parametric forms. Multiple integrals: Double and triple integrals – Change of variables – Change of order of integration. Applications: Finding Areas and Volumes.
UNIT IV	Special functions Beta and Gamma functions- Properties - Relation between Beta and Gamma functions -Evaluation of improper integrals. Applications: Evaluation of integrals.
UNIT V	Vector Differentiation Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities. Applications: Equation of continuity, potential surfaces
UNIT VI	Vector Integration Line integral – Work done – Potential function – Area- Surface and volume integrals Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and related problems. Applications: Work done, Force.

TEXT BOOKS	
1.	**B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2.	**N.P.Bali**, Engineering Mathematics, Lakshmi Publications.

3.	**Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
REFERENCE BOOKS	
1.	**Greenberg**, Advanced Engineering Mathematics, 2nd edition, Pearson edn
2.	**Peter O'Neil**, Advanced Engineering Mathematics,7th edition, Cengage Learning.
3.	**D.W. Jordan and T.Smith**, Mathematical Techniques, Oxford University Press.
4.	**Srimanta Pal, SubodhC.Bhunia**, Engineering Mathematics, Oxford University Press.
5.	**Dass H.K., RajnishVerma. Er.**, Higher Engineering Mathematics, S. Chand Co. Pvt. Ltd, Delhi.

I year - II semester

ENGINEERING PHYSICS

Course Category	BSC	**Course Code**	16BH2T09
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To impart knowledge on interference phenomenon and utilizing it to design of instruments in Engineering applications.
2.	To impart knowledge on diffraction phenomenon to design optical instruments for Engineering applications.
3.	1.To impart knowledge on types of polarization, types of polarizing materials and their effects to study and design of optical instruments. 2.To impart knowledge on the lasers & their working principle
4.	To impart knowledge on fundamentals of acoustic principles & methods of production of Ultrasonic waves and study their practical applications.
5.	To impart knowledge on study of structure of materials, property relationship exhibited by the solid-state materials for their utility and to explore the nuclear power as a reliable source required to run industries
6.	To impart knowledge on materials with characteristic utility in appliances.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Apply the concepts of interference to undergo analysis of optical effects and contribute to engineering applications.	Applying
CO2	Apply studies on diffraction pattern of light to utilize in the analysis of the materials and their properties.	Analyzing
CO3	Understand concepts of polarization phenomenon, Lasers and their practical role play in engineering applications.	Understanding
CO4	Analyze the basics requirements of architectural acoustics for structural designing & applications of Ultrasonic waves in the Non-destructive testing techniques.	Analyzing
CO5	Analyze the structures and properties of solid-state materials and apply the	Analyzing

	basics of Nuclear Physics & production of nuclear energy in Energy crisis.	
CO6	Apply magnetic & dielectric of materials as per their properties in engineering applications.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	-	-	-
CO3	3	-	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	2	2	-	-	-	-	-	-	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	2	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**INTERFERENCE:** Introduction-Principle of Superposition – Coherent Sources – Interference in thin films (reflection geometry)- Interference in wedge shaped films – Newton's rings –working principle of Interferometer, applications
UNIT II	**DIFFRACTION:** Introduction -Fraunhoffer diffraction at single slit - Cases of double slit, N-slits & Circular Aperture (Qualitative treatment only)-Grating equation - Resolving power of a grating, Telescope and Microscopes- applications.
UNIT III	**POLARIZATION:** Introduction -Types of Polarization – Methods of production – double refraction-Nicol Prism -Quarter wave plate and Half Wave plate – Working principle of Polari meter (Sacharimeter)-applications.
UNIT IV	**ACOUSTICS:** Introduction- Acoustics of concert hall- -. Reverberation time – Sabine's formula - Absorption Coefficient and its Measurement- Effecting factors and Remedies. ULTRASONICS: Introduction -Production by Magnetostriction & Piezo electric effect- Detection Methods- Ultrasonic transducers -Non Destructive Testing-Applications.
UNIT V	**CRYSTALLOGRAPHY & X-RAY DIFFRACTION:** Introduction-Basis and lattice – Unit cell - Coordination number -Bravais lattice-Crystal Systems- Packing fractions –Crystal directions and planes-Miller indices – Separation between successive (h k l) planes – Bragg's law - Bragg's X- ray spectrometer. **NUCLEAR ENERGY** – SOURCE OF POWER: Mass defect & Binding Energy – Fusion and Fission as sources – Fast breeder Reactors.
UNIT VI	**MAGNETISM:** Introduction-Basics of Magnetism-Origin of Magnetic Moment - Classification of Magnetic Materials- Weiss theory-Domain Theory-Hysteresis- Eddy Current Losses- -Hard and soft Magnetic materials- applications **DIELECTRICS:** Electric Polarization – Dielectrics in DC and AC fields – Internal field – Clausius -Mosotti Equation - Loss, Breakdown and strength of dielectric materials – Ferroelectric Hysteresis and applications.

TEXT BOOKS

1.	A Text book of Engineering Physics – by Dr. M.N.Avadhanulu and Dr.P.G.Kshirasagar S.Chand & Company Ltd., (2014)
2.	Physics for Engineers by M.R.Srinasan, New Age international publishers (2009)
REFERENCE BOOKS	
1.	Physics by Resnick,Halliday&Krane ,Volume I&II ,John Wiley&sons(2002)
2.	Engineering Physics by D.K.Bhattacharya and Poonam Tandon , Oxford press (2015)
3.	Applied Physics by P.K.Palanisamy , Scitech publications (2014)
4.	Lasers and Non-Linear optics by B.B.Laud , Newage international publishers (2008

I year - II semester

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course Category	ESC	**Course Code**	16EE2T03
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To learn the basic principles of electrical circuital law's and analysis of networks.
2.	To understand the principle of operation and construction details of DC machines & Transformers.
3.	To understand the principle of operation and construction details of alternator and 3-Phase induction motor.
4.	To study the operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
5.	To learn the operation of PNP and NPN transistors and various amplifiers.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Analyze and solve electric circuits.	Analyzing
CO2	Outline the operation of DC generators, 3-point starter and testing of DC machines by Swinburne's Test.	Understanding
CO3	Analyze the performance of single-phase transformer.	Analyzing
CO4	Get explore on the operation of 3-phase alternator and 3-phase induction motors.	Understanding
CO5	Characterize semiconductors, diodes and transistors.	Analyzing

CO6	Design op-amp circuits to perform arithmetic operations.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-
CO3	3	2	-	1	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	2	-	-	-	-	-	-	-	1	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	1	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**Electrical Circuits:** Basic definitions - Types of network elements - Ohm's Law -Kirchhoff's Laws - Inductive networks - Capacitive networks – Series - Parallel circuits - Star-delta and delta-star transformations.
UNIT II	**DC Machines:** Principle of operation of DC generator – EMF equation - Types of DC machine – Torque equation – Applications – Three-point starter - Speed control methods of DC motor – Swinburne's Test.
UNIT III	Principle of operation and construction of single-phase transformers – EMF equation – Losses – OC & SC tests - Efficiency and regulation.
UNIT IV	**AC Rotating Machines:** Principle of operation and construction of alternators– Types of alternators – Principle of operation of 3-Phase induction motor – Slip-torque characteristics - Efficiency – Applications. Principle of operation of synchronous motor
UNIT V	**Semiconductor Devices and Applications:** PN junction diodes - Diode applications (Half wave and bridge rectifiers) PNP and NPN junction transistor, transistor as an amplifier- Transistor amplifier. Frequency response of CE amplifier - Concepts of feedback amplifier. Transistor applications.
	Linear IC's and Applications: Introduction to Operational Amplifiers- Characteristics of Operational amplifiers (OP-AMP) - application of OP-AMPs as inverting, non-inverting, integrator and differentiator. Introduction to Thyristor.

TEXT BOOKS	
1.	Electrical Technology by Surinder Pal Bali, Pearson Publications.
2.	Electronic Devices and Circuits, R.L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.
REFERENCE BOOKS	

1.	Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group
2.	Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah,TMH Publications
3.	Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
4.	Basic Electrical Engineering by Nagsarkar,Sukhija, Oxford Publications,2nd edition
5.	Industrial Electronics by G.K. Mittal, PHI.
WEB RESOURCES	
1.	http://www.ncert.nic.in/html/learning_basket/electricity/electricity/machine/motor.html
2.	www.electricaleasy.com
3.	www.nptel.ac.in/courses/108108076/

I year - II semester

ENGINEERING DRAWING

Course Category	ESC	**Course Code**	16ME2T02
Course Type	Theory	**L-T-P-C**	2-0-3-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To introduce the students to use drawing instruments and to draw polygons, Engineering Curves.
2.	To introduce the students to use scales and orthographic projections, projections of points.
3.	The objective is to make the students draw the projections of simple lines inclined to one or both the planes.
4.	The objective is to make the students draw the projections of the plane inclined to both the planes.
5.	The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.
6.	The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Construct polygons and curves.	Applying
CO2	Construct scales and Identify the position of points and lines.	Applying
CO3	Identify the position of lines inclined to both the planes.	Applying

CO4	Analyze the location and position of plane figures.	Analyzing
CO5	Analyze the location of solid bodies.	Analyzing
CO6	Develop an isometric view and orthographic view.	Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1	-	-	-	-	-	-	-	-	2	1
CO2	1	3	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	1	1	-	-	-	-	-	-	-	-	2	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-	2	-
CO6	3	2	2	1	2	-	-	-	-	-	-	-	2	2

COURSE CONTENT	
UNIT I	**Polygons:** Constructing regular polygons by general methods, inscribing and describing polygons on circles. **Curves:** Parabola, Ellipse and Hyperbola by general methods, cycloids, involutes, tangents & normal for the curves.
UNIT II	**Scales:** Plain scales, diagonal scales and Vernier scales **Orthographic Projections**: Horizontal plane, vertical plane, profile plane, importance of reference lines, projections of points in various quadrants. Projections of lines, lines parallel either to the reference planes (HP, VP or PP)
UNIT III	Projections of lines inclined to both the planes, determination of true lengths, angle of inclination and traces- HT, VT.
UNIT IV	Projections of planes: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.
UNIT V	Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes.
UNIT VI	Conversion of isometric views to orthographic views, Conversion of orthographic views to isometric views.

TEXT BOOKS	
1.	Engineering Drawing by N.D. Bhatt, Chariot Publications
2.	Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age International

REFERENCE BOOKS	
1.	Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2.	Engineering Graphics for Degree by K.C. John, PHI Publishers
3.	Engineering Graphics by PI Varghese, McGrawHill Publishers
4.	Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers
WEB RESOURCES	
1.	http://nptel.ac.in/courses/112103019/
2.	http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html
3.	http://www.engineeringdrawing.org

I year - II semester

ENGLISH - COMMUNICATION SKILLS LAB- II

Course Category	HSMC	**Course Code**	16BH2L37
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1.	To enable the students to learn demonstratively the communication skills of listening, speaking, reading and writing.

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Make use of argumentative and critical thinking skills by elaborating ideas relevantly and improve team working skills.	Creating
CO2	Select and adopt appropriate non-verbal communication and other presentation required skills to deliver effective presentation with clarity and impact. And to develop fluency in communication and present themselves in interviews confidently.	Remembering
CO3	Analyze and compose the unique qualities of professional writing styles to meet the needs and demands in both academics and professions to demonstrate the harmony of language and avoiding mistakes.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	2	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-

COURSE CONTENT	
UNIT I	Debating- Practice work
UNIT II	Group Discussion- Practice work
UNIT III	Presentation Skills- Practice work
UNIT IV	Interview Skills- Practice work
UNIT V	1.Email 2.Curriculum Vitae- Practice work
UNIT VI	1.Idiomatic Expressions 2.Common Errors in English- Practice work

TEXT BOOKS	
1.	Strengthen your communication skills by Dr M Hari Prasad, Dr Salivendra Raju and Dr G Suvarna Lakshmi, Maruti Publications.
2.	English for Professionals by Prof Eliah, B.S Publications, Hyderabad.
3.	Unlock, Listening and speaking skills 2, Cambridge University Press
4.	Spring Board to Success, Orient BlackSwan
REFERENCE BOOKS	
1.	Let us hear them speak, Jayashree Mohanraj, Sagetexts
2.	Professional Communication, Aruna Koneru, Mc Grawhill Education
3.	Cornerstone, Developing soft skills, Pearson Education

I year - II semester

ENGINEERING/APPLIED PHYSICS LAB

Course Category	BSC	**Course Code**	16BH2L03
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Learn to utilize the basics of Interference, diffraction in physics through experimentation.	Understanding
CO2	Interpret and analyse concepts of waves and oscillations through experimentation.	Understanding
CO3	Apply the basics of current and electricity, semiconductors in engineering projects.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-	-	-

LIST OF EXPERIMENTS:	
1.	To verify the Laws of Transverse vibrations of a stretched string using sonometer
2.	To determine the Rigidity Modulus of a given wire using Torsional Pendulum

3.	To determine the velocity of sound in air using Volume Resonator Method
4.	To determine the acceleration due to gravity using Compound Pendulum
5.	To determine the frequency of an electric tuning fork using Melde's Apparatus
6.	To Study the V-I Characteristics and determine the breakdown voltage of a Zener Diode
7.	To determine the wavelength of a given source using diffraction Grating in Normal Incidence Method
8.	To determine the energy Band Gap of a Semiconductor using P-N Junction diode
9.	To Study the variation of the Magnetic field along the axis of a current carrying circular coil using Stewart and Gee's Apparatus
10.	To study the R-I Characteristics of a Thermistor
11.	To determine the refractive index of the medium of the film using the formation of Newton's Rings.
12.	To determine the thickness of a paper using the formation of parallel fringes
13.	To Determine Planck's constant using photoconductor
14.	To determine the refractive index of the Prism using spectrometer

REFERENCE BOOKS	
1.	Engineering Physics Lab Manual by Dr.Y.Aparna & Dr.K.Venkatesswara Rao.(V.G.S. Book Links)
2.	Physics Manual cum Observation book (College Designed Manual).

I year - II semester

ENGINEERING/APPLIED PHYSICS-VIRTUAL LAB ASSIGNMENTS

Course Category	BSC	**Course Code**	16BH2L04
Course Type	Laboratory	**L-T-P-C**	0-0-2-0
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

LIST OF EXPERIMENTS:	
1.	Hall Effect
2.	Crystal Structure
3.	Hysteresis
4.	Brewster's angle

5.	Numerical Aperture of Optical fiber
6.	Photoelectric Effect
7.	Simple Harmonic Motion
8.	LASER – Beam Divergence and Spot size
9.	B-H curve
10.	Michelson's interferometer

WEB RESOURCES	
1.	www.vlab.co.in

I year - II semester

ENGINEERING WORKSHOP

Course Category	ESC	**Course Code**	16ME2L01
Course Type	Theory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
	ENGINEERING WORKSHOP
1.	To impart hands-on practice on basic engineering trades and skills.
	IT WORKSHOP
2.	Understand the basic components and peripherals of a computer.
3.	To become familiar in configuring a system.
4.	Learn the usage of productivity tools.
5.	Acquire knowledge about the netiquette and cyber hygiene.

By the end of the Course, the Student will be able to:

CO	Description	Blooms Taxonomy Level
CO1	Practice on manufacturing of components using workshop trades including fitting and carpentry and Design different types of models by using workshop trades including black smithy and tin smithy.	Creating
CO2	Apply basic electrical engineering knowledge for house wiring practice.	Applying
CO3	Understand the fundamentals of Computers its architectures and system software executing on it.	Understanding
CO4	Gain knowledge about working of internet other relevant information exchange mechanisms as well as tools for data analysis and data interpretations.	Analyzing

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	3	-	-	-	-	-	-	-	3	3
CO2	3	-	3	-	3	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	2	2
C04	3	3	3	3	-	-	-	-	-	-	-	-	2	2

COURSE CONTENT

ENGINEERING WORKSHOP

Carpentry:

1. T-Lap Joint
2. Cross Lap Joint
3. Dovetail Joint
4. Mortise and Tenon Joint

Fitting:

1. V Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit

Black Smithy:

1. Round rod to Square
2. S-Hook
3. Round Rod to Flat Ring
4. Round Rod to Square headed bolt

House Wiring:

1. Parallel / Series Connection of three bulbs
2. Stair Case wiring
3. Florescent Lamp Fitting
4. Measurement of Earth Resistance

Tin Smithy:

1. Taper Tray

	2. Square Box without lid 3. Open Scoop 4. Funnel
IT WORKSHOP	**System Assembling, Disassembling and identification of Parts / Peripherals** **Operating System Installation**-Install Operating Systems like Windows, Linux along with necessary Device Drivers. **MS-Office / Open Office** a. **Word** - Formatting, Page Borders, Reviewing, Equations, symbols. b. **Spread Sheet** - organize data, usage of formula, graphs, charts. c. **Power point** - features of power point, guidelines for preparing an effective presentation. d. **Access**- creation of database, validate data. **Network Configuration & Software Installation**-Configuring TCP/IP, proxy and firewall settings. Installing application software, system software & tools. **Internet and World Wide Web**-Search Engines, Types of search engines, netiquette, cyber hygiene. Trouble Shooting-Hardware trouble shooting, Software trouble shooting. **MATLAB-** basic commands, subroutines, graph plotting. **LATEX**-basic formatting, handling equations and images.

TEXT BOOKS

1.	Computer Hardware, Installation, Interfacing, Troubleshooting and Maintenance, K.L. James, Eastern Economy Edition.
2.	Microsoft Office 2007: Introductory Concepts and Techniques, Windows XP Edition by Gary B. Shelly, Misty E. Vermaat and Thomas J. Cashman (2007, Paperback).
3.	LATEX- User's Guide and Reference manual, Leslie Lamport, Pearson, LPE, 2/e.
4.	Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Rudraprathap, Oxford University Press, 2002.
5.	Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson, 2008
6.	The Complete Computer upgrade and repair book, 3/e, Cheryl A Schmidt, Dreamtech.
7.	Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech.

II year - I semester

METALLURGY & MATERIALS SCIENCE

Course Category	PCC	**Course Code**	16ME3T04
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To know the basic concepts of bonds in metals and alloys. To understand the basic requirements for the formation of solid solutions and other compounds.
2.	To understand the regions of stability of the phases that can occur in an alloy system in order to solve the problems in practical metallurgy.
3.	To study the basic differences between cast irons and steels, their properties and practical applications.
4.	To study the effect of various alloying elements on iron-iron carbide system. To understand the various heat treatment and strengthening processes used in practical applications.
5.	To study the properties and applications of widely used non-ferrous metals and alloys so as to use the suitable material for practical applications.
6.	To study the properties and applications of ceramic, composite and other advanced materials so as to use the suitable material for practical applications.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Recall various types of bonds and understanding structure of metals and its alloys.	Understanding
CO2	Understand equilibrium diagrams while studying various phases while drawing it.	Understanding
CO3	Distinguish the properties and applications between steel and cast iron.	Analyzing
CO4	Analyze various heat treatment processes of alloys.	Analyzing
CO5	Study various properties and applications of Non-ferrous metals and its alloys.	Understanding
CO6	Study properties of ceramics and classification of ceramics.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	1	-	1	1	-	-	-	-	1	1	2
CO2	2	2	1	1	1	-	-	-	-	-	-	1	1	-
CO3	3	1	1	1	1	-	-	-	-	-	-	1	1	-
CO4	3	2	2	1	1	-	1	-	-	-	-	1	1	-

CO5	2	1	1	2	1	-	1	-	-	-	-	1	1	-
CO6	2	1	1	2	1	-	1	-	-	-	-	1	1	-

COURSE CONTENT	
UNIT I	**Structure of Metals and Constitution of alloys:** Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size. Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.
UNIT II	**Equilibrium Diagrams:** Experimental methods of construction of equilibrium diagrams, Isomorphism alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Bi-Cd and Fe-Fe3C.
UNIT III	**Cast Irons and Steels:** Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.
UNIT IV	**Heat treatment of Alloys:** Effect of alloying elements on Fe-Fe3C system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Harden ability, surface - hardening methods, Age hardening treatment.
UNIT V	**Non-ferrous Metals and Alloys:** Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys.
UNIT-VI	**Ceramic and composite materials:** Crystalline ceramics, glasses, cremates, abrasive materials, non-material's – definition, properties and applications of the above. Classification of composites, various methods of component manufacture of composites Hand and man layup process, Filament winding process, Continuous pultrusion process, particle – reinforced materials, fiber reinforced materials, metal – matrix composites and C – C composites.

TEXT BOOKS	
1.	Introduction to Physical Metallurgy - Sidney H. Avener - McGrawHill
2.	Essential of Materials science and engineering - Donald R.Askeland - Thomson.
REFERENCE BOOKS	
1.	Material Science and Metallurgy – Dr.V.D.kodgire
2.	Materials Science and engineering - Callister&Baalasubrahmanyam
3.	Material Science for engineering students – Fischer – Elsevier Publishers.
4.	Material science and Engineering - V. Rahghavan
5.	Introduction to Material Science and Engineering – Yip-Wah Chung CRC Press.
6.	Material Science and Metallurgy – U. C. Jindal – Pearson Publications
WEB RESOURCES	
1.	http://nptel.ac.in/courses/113105024/7.

2.	http://nptel.ac.in/courses/112104122/12.
3.	http://nptel.ac.in/courses/113106031/17.
4.	http://nptel.ac.in/courses/113104068/36.

II year - I semester

MECHANICS OF SOLIDS

Course Category	PCC	**Course Code**	16ME3T05
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	Engineering Mechanics	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To calculate stress, strain, and deformation for basic geometries subjected to axial loading and thermal effects.
2.	To calculate bending and shear stresses from shear force and bending moment diagram for cantilever, simply supported and over hanging beams of transverse loading.
3.	To Calculate shear stresses for torsion loading and identify the location of shear centers for the various sections of beams.
4.	To analyse the deflections in various beams subjected to various loading conditions
5.	Analyse and calculate bi-axial stresses in thick and thin cylinders, also the spherical shells.
6.	Analyse and calculate the stresses in shafts and failure loads of column with various boundary conditions

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Explain basic concepts of stress and strain in solids and apply this knowledge during the analysis.	Understanding
CO2	Analyze the shear force and bending moment develops in a beam while solving complex problems.	Analyzing
CO3	Examine the bending stress and shear stress in beams and can select the appropriate geometry for the requirement.	Analyzing
CO4	Inspect the slope and deflection of the beam by various methods subjected to point load, UDL.	Analyzing
CO5	Identify the stresses in thin and thick cylinders subjected to internal pressure.	Applying
CO6	Apply the buckling load for columns with different end conditions and Identify appropriate shaft size by applying the principles of torsion.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	-	1	1	-
CO2	3	3	2	-	-	-	-	-	-	-	-	1	1	-

CO3	3	3	2	-	-	-	-	-	-	-	-	1	1	-
CO4	3	3	2	-	-	-	-	-	-	-	-	1	1	-
CO5	3	3	2	-	-	-	-	-	-	-	-	1	1	-
CO6	3	3	2	-	-	-	-	-	-	-	-	1	1	-

COURSE CONTENT	
UNIT I	**SIMPLE STRESSES & STRAINS :** Mechanical properties of materials – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety-Margin of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.
UNIT II	**SHEAR FORCE AND BENDING MOMENT:** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.
UNIT III	**FLEXURAL STRESSES:** Theory of simple bending – Assumptions – Derivation of bending equation: M/ I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections. **SHEAR STRESSES:** Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.
UNIT IV	**DEFLECTION OF BEAMS:** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams.
UNIT V	**THIN CYLINDERS:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells. **THICK CYLINDERS:** –lame's equation – cylinders subjected to inside & outside pressures –compound cylinders.
UNIT VI	**TORSION:** Introduction-Derivation- Torsion of Circular shafts- Stresses and strains in pure Shear- Transmission of power by circular shafts, Shafts in series, Shafts in parallel- Strain energy in torsion. **COLUMNS:** Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula.

TEXT BOOKS	
1.	Strength of Materials – S. Ramamrutham/Dhanpat Rai Publications
2.	Solid Mechanics, by E.P.Popov/Prentice Hall Publications
3.	Strength of Materials – R.K. Rajput/S.Chand
REFERENCE BOOKS	
1.	Strength of Materials -By Jindal, Umesh Publications.
2.	Analysis of structures by Vazirani and Ratwani.
3.	Mechanics of Structures Vol-III, by S.B.Junnarkar.

4.	Strength of Materials by S.Timshenko.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/105106116/
2.	https://en.wikipedia.org/wiki/Strength_of_materials
3.	https://www.youtube.com/watch?v=PnSoBvwbXN0
4.	http://www.nptelvideos.in/2012/12/strength-of-materials.html

II year - I semester

THERMODYNAMICS

Course Category	PCC	**Course Code**	16ME3T06
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Illustrate basic concepts of thermodynamics and thermometry.
2.	Relate the correlations for first law of thermodynamics and apply to different thermodynamic systems.
3.	Relate the correlations for second and third law and to analyze various concepts associated.
4.	Describe the process of steam formation and its representation on property diagram with the help of steam tables and charts.
5.	Describe various fuels and combustion and analyze the mixture of perfect gases.
6.	Analyze various air standard cycles

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Illustrate basic concepts of thermodynamics and thermometry.	Understanding
CO2	Relate the correlations for first law of thermodynamics and apply to different thermodynamic systems.	Analyzing
CO3	Relate the correlations for second and third law and to analyze various concepts associated.	Analyzing
CO4	Describe the process of steam formation and its representation on property diagram with the help of steam tables and charts.	Remembering
CO5	Describe various fuels and combustion and analyze the mixture of perfect gases.	Analyzing
CO6	Analyze various air standard cycles.	Analyzing

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	-	-	-	-	-	1	2	2	-

CO2	3	2	2	2	-	-	2	-	-	-	-	2	2	-
CO3	2	2	2	2	-	1	-	-	-	-	-	2	2	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	2	-
CO5	3	2	2	2	-	1	-	-	-	-	-	2	2	-
CO6	3	2	2	2	-	1	-	-	-	1	-	2	2	-

COURSE CONTENT	
UNIT I	**Introduction:** Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle –Quasi – static Process, Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature.
UNIT II	Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system– Steady Flow Energy Equation. Throttling and free expansion processes – deviations from perfect gas model – Vander Waals equation of state – compressibility charts – PMM I, Limitations of first law.
UNIT III	Thermal Reservoir, Heat Engine, Refrigeration and Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, reversibility and Irreversibility, Causes of irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.
UNIT IV	Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.
UNIT V	Types of fuels - Exothermic and endothermic reactions - Combustion equations – Stoichiometry, Mixtures of perfect Gases – Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.
UNIT VI	**Power Cycles:** Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Brayton Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles. **Refrigeration Cycles**: Brayton and Rankine cycles – Performance Evaluation – combined cycles, Bell- Coleman cycle, Vapour compression cycle-performance Evaluation.

TEXT BOOKS	
1.	Engineering Thermodynamics , PK Nag, TMH.
2.	Thermodynamics– Y.A.Cengel & M.A.Boles , 7th Edn - McGrawHill
REFERENCE BOOKS	
1.	Thermodynamics – J.P.Holman , McGrawHill
2.	Basic Engineering Thermodynamics – A.Venkatesh – Universities press.
3.	An Introduction to Thermodynamics - Y.V.C.Rao – Universities press.
4.	Thermodynamics – W.Z.Black & J.G.Hartley, 3rd Edn Pearson Publ.

5.	Engineering Thermodynamics – R K Rajput, Laxmi publications Ltd..
6.	Engineering Thermodynamics – P.Chattopadhyay – Oxford Higher Edn Publ.
7.	Fundamentals of Classical Thermodynamics - G.J.VanWylen& Sonntag.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/112105123/1
2.	http://nptel.ac.in/courses/Webcoursecontents/IITKANPUR/Basic_Thermodynamics/ui/TOC.html
3.	http://www.nptelvideos.in/2012/12/basic-thermodynamics.html

II year - I semester

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Course Category	HSMC	**Course Code**	16BH3T14
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To understand the concept and nature of Managerial Economic s and its relationship with other disciplines, Concept of Demand and Demand forecasting.
2.	To understand the concept of Production function, Input Output relationship, different Cost Concepts and Concept of Cost- Volume-Profit Analysis.
3.	To understand the Nature of Competition, Characteristics of Pricing in the different market structure and significance of various pricing methods.
4.	To know the different forms of Business organization and their Merits and Demerits both public & private Enterprises and the concepts of Business Cycles.
5.	To understand the different Accounting Systems preparation of Financial Statements.
6.	To understand the concept of Capital, Capitalization, Capital Budgeting and to know the techniques used to evaluate Capital Budgeting proposals by using different methods and uses of different tools for performance evaluation.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Make use of concepts of managerial economics and demand in managerial decision making and predicting demand for goods and services.	Understanding
CO2	Assess the functional relation among production, cost of production, cost concepts and break even analysis.	Applying
CO3	Classify market structures as perfect and imperfect markets for price and output decisions.	Understanding
CO4	Appraise the forms of business organisations and trade cycles in economic growth.	Understanding
CO5	Apply accounting principles in recording transactions for the purpose of preparing financial statements.	Applying
CO6	Adapt capital budgeting techniques to take capital budgeting decisions.	Applying

Contribution of Course Outcomes towards achievement of Program														
Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**

CO1	-	2	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	1	-	-	-	-	-	-	-	-	3	-	1	-
CO3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO5	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO6	-	3	-	-	-	-	-	-	-	-	1	-	1	-

COURSE CONTENT	
UNIT I	**Introduction to Managerial Economics and demand Analysis:** Definition of Managerial Economics and Scope-Managerial Economics and its relation with other subjects-Basic Economic Tools used in Managerial Economics-Concepts of Demand-Types- Determents-Law of Demand its Exception-Elasticity of Demand-Types and Measurement- Law of Supply -Demand forecasting and its Methods.
UNIT II	**Production and Cost Analyses:** Production Function-Isoquants and Isocosts-Law of Variable proportions- Laws of Returns to Scale-Cobb-Douglas Production Function-Economies of Scale-Cost Concepts- Fixed vs Variable Costs-Out of Pocket Costs vs Imputed Costs-Cost Volume Profit Analysis-Determination of Break-Even Point (Simple Problems)
UNIT III	**Introduction to Markets, Theories of the Firm & Pricing Policies:** Market Structures: Perfect Competition, Monopoly and Monopolistic and Oligopoly – Features – Price, Output Determination – Managerial Theories of firm: Marris and Williamson‟s models – Methods of Pricing: Limit Pricing, Market Skimming Pricing, Internet Pricing: Flat Rate Pricing, Usage sensitive, Transaction based pricing, Priority Pricing.
UNIT IV	**Types of Business Organization and Business Cycles:** Features and Evaluation of Sole Trader – Partnership – Joint Stock Company – State/Public Enterprises and their forms **– Business Cycles – Meaning and Features – Phases of Business Cycle.**
UNIT V	**Introduction to Accounting:** Introduction to Double Entry Systems-Journal-Ledger- Trail Balance - Preparation of Financial Statements - Analysis and Interpretation of Financial Statements-Ratio Analysis – liquidity ratios, profitability ratios, solvency ratios, turnover ratios– Preparation of the Funds flow Statement (Simple Problems)
UNIT VI	**Capital and Capital Budgeting: Capital Budgeting:** Meaning of Capital-Capitalization-Sources of Finance (with special reference to Shares and Debentures)-Meaning of Capital Budgeting-Need for Capital Budgeting-Techniques of Capital Budgeting-Traditional and Modern Methods.

TEXT BOOKS	
1.	Dr. N. Appa Rao, Dr. P. Vijay Kumar: „Managerial Economics and Financial Analysis‟, Cengage Publications, New Delhi – 2011
2.	Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011
3.	Prof. J.V.Prabhakara rao, Prof. P. Venkata rao. „Managerial Economics and Financial Analysis‟, Ravindra Publication.
REFERENCE BOOKS	
1.	V. Maheswari: Managerial Economics, Sultan Chand.
2.	Suma Damodaran: Managerial Economics, Oxford 2011.

3.	Dr. B. Kuberudu and Dr. T. V. Ramana: Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.
4.	Vanitha Agarwal: Managerial Economics, Pearson Publications 2011.
5.	Sanjay Dhameja: Financial Accounting for Managers, Pearson.
6.	Maheswari: Financial Accounting, Vikas Publications.
7.	S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012

II year - I semester

FLUID MECHANICS & HYDRAULIC MACHINES

Course Category	PCC	**Course Code**	16ME3T07
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1.	To provide knowledge on different fluid properties, Manometry and to estimate the Hydro static forces on submerged bodies.
2.	To learn about the different types of fluid flows, flow patterns and forces behind the flow and to study the energy equation and Momentum equation and also to find the losses occurs in flow through the pipes, their corresponding problems.
3.	To provide knowledge about different concepts of boundary layer theory, flow separation, basic concepts of velocity profiles, dimensionless numbers and dimensional analysis.
4.	To learn about the hydrodynamic forces acting on vanes and their performance evaluation.
5.	To study types of centrifugal Pumps, work done and efficiency and also study about performance of pumps & characteristic curves and also about reciprocating pumps.
6.	To study different turbines, draft tube theory and to determine the function efficiency and governing, performance characteristics of different types of turbines.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Blooms Taxonomy Level**
CO1	Apply the acquired knowledge about fluid properties, buoyancy and floatation.	Applying
CO2	Solve the problems related to fluid flow through pipes.	Applying
CO3	Distinguish concepts of boundary layer theory, velocity profiles and dimensional analysis.	Analyzing
CO4	Identify hydro dynamic forces acting on different vanes.	Analyzing
CO5	Analyze the performance of pumps.	Analyzing
CO6	Examine the performance characteristics of hydraulic turbines.	Analyzing

Contribution of Course Outcomes towards achievement of Program
Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2	2	2	-	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	-	-	-	-	-	-	-	-	-	1	1	-
CO4	3	3	-	-	-	-	-	-	-	-	-	1	1	-
CO5	3	3	-	-	-	-	-	-	-	-	-	1	1	-
CO6	3	3	-	-	-	-	-	-	-	-	-	1	1	-

COURSE CONTENT	
UNIT I	**FLUID STATICS:** Dimensions and units: physical properties of fluids-specific gravity, viscosity and its significance, surface tension, capillarity, vapour pressure. Atmospheric gauge and vacuum pressure – measurement of pressure. Manometers- Piezometer, U-tube, inverted and differential manometers. Pascal's law, hydrostatic law. **BUOYANCY AND FLOATATION:** Meta centre, stability of floating body. Submerged bodies. Calculation of meta centre height. Stability analysis and applications.
UNIT II	**FLUID KINEMATICS:** Introduction, flow types. Equation of continuity for one dimensional flow. Circulation and vorticity. Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow. **FLUID DYNAMICS:** surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend. **CLOSED CONDUIT FLOW:** Reynold's experiment- Darcy Weisbach equation-Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.
UNIT III	**BOUNDARY LAYER THEORY:** Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles. **DIMENSIONAL ANALYSIS:** Similitude and modelling – Dimensionless numbers.
UNIT IV	**BASICS OF TURBO MACHINERY:** hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.
UNIT V	**CENTRIFUGAL PUMPS:** Classification, working, work done – manometric head-losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH. **RECIPROCATING PUMPS:** Working, Discharge, slip, indicator diagrams.
UNIT VI	**HYDRAULIC TURBINES:** classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube- theory-functions and efficiency. **PERFORMANCE OF HYDRAULIC TURBINES:** Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems-hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors and oscillators. Advantages, limitations and applications.

TEXT BOOKS	
1.	Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2.	Fluid Mechanics and Hydraulic Machines by Rajput.
REFERENCE BOOKS	
1.	Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2.	Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3.	Hydraulic Machines by Banga & Sharma, Khanna Publishers.
4.	Instrumentation for Engineering Measurements by James W. Dally, William E. Riley, John Wiley &

	Sons Inc. 2004 (Chapter 12 – Fluid Flow Measurements)
5.	Fluid Mechanics and Hydraulic Machines by Domkundwar & Domkundwar, Dhanpatrai & Co.
WEB RESOURCES	
1.	http://nptel.iitm.ac.in/courses
2.	http://nptel.iitm.ac.in/courses/105101082/
3.	http://nptel.iitm.ac.in/courses/105101082/
4.	http://www.youtube.com/watch?v=FENCiAEfaA&feature=player_detailpae
5.	http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv078Page1.htm
6.	http://www.learnerstv.com/video/Free-video-Lecture-2630-Engineering.htm
7.	http://www.learnerstv.com/video/Free-video-Lecture-2654-Engineering.htm

II year - I semester

COMPUTER AIDED ENGINEERING DRAWING PRACTICE

Course Category	PCC	**Course Code**	16ME3T08
Course Type	Theory & laboratory	**L-T-P-C**	3-3-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The knowledge of projections of solids is essential in 3D modeling and animation. The student will be able to draw projections of solids. The objective is to enhance the skills they already acquired in their earlier course in drawing of projection and sections of solids.
2.	The knowledge of development of surfaces of solids is required in designing and manufacturing of the objects. Whenever two or more solids combine, a definite curve is seen at their intersection. The intersection of solids also plays an important role in designing and manufacturing. The objective is to impart this knowledge through this topic.
3.	Isometric projections provide a pictorial view with a real appearance. Perspective views provides a realistic 3D View of an object. The objective is to make the students learn the methods of Iso and Perspective views.
4.	The objective is to introduce various commands in AutoCAD to draw the geometric entities and to create 2D and 3D wire frame models.
5.	By going through this topic, the student will be able to understand the paper- space environment thoroughly.
6.	To make the students create geometrical model of simple solids and machine parts and display the same as an Isometric, Orthographic or Perspective projection.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Draw the auxiliary projections of the various types of solids.	Applying
CO2	Develop the sections of solids.	Creating
CO3	Create perspective views of a given 3D object/part.	Creating
CO4	Understand the AutoCAD commands.	Understanding
CO5	Understand view points and view ports	Understanding
CO6	Create 3D views using AutoCAD.	Creating

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO3	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO6	3	2	2	-	-	-	-	-	-	-	-	3	3	-

COURSE CONTENT	
UNIT I	**PROJECTIONS OF SOLIDS:** Projections of Regular Solids inclined to both the planes. Auxiliary Views, Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone.
UNIT II	**DEVELOPMENT OF SURFACES:** Development of lateral surfaces of vertical prism, cylinder, pyramid, and cone truncated by surfaces of inclined to HP alone. Development of surfaces of vertical cylinder and prism with cylindrical cut outs perpendicular to the axis. Interpenetration of Right Regular Solids – Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone.
UNIT III	**ISOMETRIC PROJECTIONS:** Principles of Isometric Projection – Isometric Scale – Isometric Views. Conventions– Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non-isometric lines. Isometric Projection of Spherical Parts. Transformation of Projections: Conversion of Isometric Views to Orthographic Views – Conventions.
UNIT IV	**Introduction to Computer aided Drafting:** Generation of points, lines, curves, polygons, dimensioning. Types of modeling: object selection commands – edit, zoom, hatching, pattern filling, utility commands, 2D wire frame modeling, 3D wire frame modeling.
UNIT V	**View points and view ports:** view point coordinates and view (s) displayed, examples to exercise different options like save restore, delete, joint, single option.
UNIT VI	**Computer aided Solid Modeling:** Isometric projections, orthographic projections of isometric projections, modeling of simple solids, Modeling of Machines & Machine Parts.

TEXT BOOKS	
1.	Engineering Graphics, K.C. john, PHI Publications
2.	Engineering drawing by N.D Bhatt , Charotar publications.
REFERENCE BOOKS	
1.	Mastering Auto CAD 2013 and Auto CAD LT 2013 – George Omura, Sybex.
2.	Auto CAD 2013 fundamentals- Elisemoss, SDC Publ.
3.	Engineering Drawing and Graphics using Auto Cad – T Jeyapoovan, vikas.

4.	Engineering Drawing + Auto CAD – K Venugopal, V. Prabhu Raja, New Age.
5.	Engineering Drawing – RK Dhawan, S Chand
6.	Engineering Drawing – MB Shaw, BC Rana, Pearson
7.	Engineering Drawing – KL Narayana, P Kannaiah, Scitech.
8.	Engineering Drawing – Agarwal and Agarwal, Mc Graw Hill
9.	Engineering Graphics – PI Varghese, Mc Graw Hill.
10.	Text book of Engineering Drawing with auto-CAD, K.venkata reddy / B.S. publications.

II year - I semester

ELECTRICAL & ELECTRONICS ENGINEERING LAB

Course Category	ESC	**Course Code**	16EE3L03
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

By the end of the Course, the Student will be able to:

CO	Description	Blooms Taxonomy Level
CO1	Plot characteristics of semiconductor devices and machines	Applying
CO2	Analyze the frequency response of BJT amplifiers	Analyzing

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	2	-	-	-	1	-
CO2	2	1	1	-	-	-	-	-	2	-	-	-	1	-

LIST OF EXPERIMENTS:

1.	CRO and its usage in various measurements.
2.	Diode Characteristics and rectifier application.
3.	BJT Characteristics.
4.	SCR Characteristics and rectifier application.
5.	Frequency Response of CE Amplifier.

6.	Frequency Response of CC Amplifier.
7.	Study of Three Point Starter.
8.	Magnetization Characteristics of DC Shunt Generator.
9.	Swinburne's Test on DC Shunt Machine.
10.	Brake Test on DC Shunt Motor.
11.	OC and SC test on Single Phase Transformer.
12.	Brake Test on Three Phase Induction Motor.

II year - I semester

METALLURGY & MECHANICS OF SOLIDS LAB

Course Category	PCC	**Course Code**	16ME3L02
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
METALLURGY LAB	
1.	*To impart practical exposure on the microstructures of various materials and their hardness evaluation.*
MECHANICS OF SOLIDS LAB	
2.	*To study the stress –strain variation in mild steel and to determine its young's modulus, to compare the analytical and experimental values of the stress and deflection in the cantilever beam, to compare the analytical and experimental values of the stress and deflection in the simply supported beam.*

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Determine the different modulus of elasticity of materials subjected to direct and indirect loads in bars, beams and springs.	Understanding
CO2	Analyze various strengths, stress- strain-curve and hardness of different materials.	Analyzing
CO3	Understand and differentiate the microstructures of ferrous alloys by using metallurgical microscope.	Understanding
CO4	Understand and differentiate the microstructures of non-ferrous alloys by using metallurgical microscope.	Understanding

Contribution of Course Outcomes towards achievement of Program														
Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	2	-	-	-	-	-	-	-	-	3	-
CO3	2	-	-	-	2	-	-	-	3	-	2	3	3	-
CO4	2	-	-	-	2	-	-	-	3	-	2	3	3	-

COURSE CONTENT	
METALLURGY LAB	
1.	Preparation and study of the Microstructure of Al
2.	Preparation and study of the Microstructure of Cu.
3.	Preparation and Study of the Microstructure of Gray Cast-iron.
4.	Preparation and Study of the Microstructure of Stainless steel
5.	Preparation and Study of the Microstructure of Brass
6.	Preparation and Study of the Microstructure Malleable Cast Iron
***Note**: Any 5 experiments are to be conducted among 6*	
MECHANICS OF SOLIDS LAB	
1.	Estimate young's modulus of Wood/Steel materials
2.	Bending test on simply supported beam steel.
3.	Bending test on simply supported beam Wood.
4.	Bending test on cantilever beam Steel
5.	Torsion test
6.	Brinell's hardness test
7.	Rockwell hardness test
8.	Test on Tension springs.

9.	Test on Compression springs
10.	Compression Test on wood.
11.	Charpy Impact test.
12.	Izod Impact test.
Note: *Any 5 experiments are to be conducted among 12*	

II year - II semester

KINEMATICS OF MACHINERY

Course Category	PCC	**Course Code**	16ME4T10
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To understand different mechanisms and their constraints.
2.	To get clear idea about planar mechanisms and spatial mechanisms.
3.	To determine velocity and acceleration of different parts in a given mechanism by using graphical as well as analytical techniques
4.	To get idea about generating cam profiles and concepts of belt drives.
5.	To understand the concepts of gears and gears trains.

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Design a suitable mechanism depending on application.	Analyzing
CO2	Apply various lower pair mechanisms.	Analyzing
CO3	Draw velocity and acceleration diagrams for different Mechanisms.	Applying
CO4	Study the follower motions and design the cam profiles.	Analyzing
CO5	Study and understand the applications of gears.	Evaluating
CO6	Select gear and gear train depending on application.	Understanding

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	1	-	-	-	-	-	1	1	2
CO2	2	2	1	1	1	-	-	-	-	-	-	-	2	2
CO3	3	1	1	1	1	-	-	-	-	-	-	-	1	1
CO4	3	2	2	1	1	-	-	-	-	-	-	-	1	1
CO5	2	1	1	2	1	-	-	-	-	-	-	-	1	1
CO6	2	1	1	2	1	-	-	-	-	-	-	-	1	1

COURSE CONTENT	
UNIT I	**Mechanisms and Machines:** Introduction: Mechanism and machine; Rigid and resistant bodies; Link; Kinematic pair; Degrees of freedom; Classification of kinematic pairs; Kinematic chain; Linkage, mechanism and structure; Mobility of mechanisms. Application of Kutzbach Criterion to Plane Mechanisms. Grubler's Criterion for Plane Mechanisms. Grashof's law. **Inversions of Mechanisms:** The four-bar chain; single and double slider crank chains.
UNIT II	**Mechanism with lower pairs:** Pantograph - straight line motion mechanisms - exact straight-line motion mechanisms- Peaucellier mechanism, Approximate straight-line motion mechanisms Watt mechanism. Condition for correct steering- Davis & Ackerman's steering gear mechanisms. **Hooke's joint:** Ratio of shaft velocities - maximum and minimum speed of driven shaft - condition for equal speeds -Angular acceleration of driven shaft - Double Hooke's joint.
UNIT III	**Velocity Analysis**: Relative velocity method -velocity of point on a link- application of relative velocity method to simple mechanisms - rubbing velocity of a joint - Instantaneous center method -body centrode and space centrode - velocity of point on a link by Instantaneous center method, location of Instantaneous center - three centers in line theorem and its application for simple mechanisms. **Acceleration Analysis**: Acceleration diagrams of a link- acceleration diagrams for simple mechanisms- coriolis component of acceleration - acceleration diagram for slotted lever quick return mechanism.
UNIT IV	**Cams:** Classification of followers and cams -terms used in radial cams - displacement, velocity and acceleration diagrams when the follower moves with uniform velocity, uniform acceleration and retardation, simple harmonic motion -construction of cam profiles. **Belt Drives:** Introduction, Belt and rope drives, selection of belt drive- types of belt drives, V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt.
UNIT V	**Toothed gearing:** Classification of toothed wheels - te1ms used in gears - law of gearing - velocity of sliding of teeth - forms of teeth - Cycloidal and involute teeth- length of path of contact-arc of contact-contact ratio- interference in involute teeth - minimum number of teeth to avoid interference. **Gear trains:** Simple, compound and reverted gear trains -epicyclic gear train -velocity ratio of epicyclic gear train-sun and planet wheels - torques in epicyclic gear train-Differential of

	an automobile.
UNIT VI	**POWER TRANSMISSIONS:** Introduction, Belt and rope drives, selection of belt drive-types of belt drives, V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains. Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

TEXT BOOKS	
1.	Theory of Machines, S. S. Rattan ,3rd edition, McGraw-Hill Publications, New Delhi.
2.	Theory of Machines, Thomas Bevan 3rd edition, CBS Publishers & Distributors, New Delhi.
REFERENCE BOOKS	
1.	Theory of Machines and Mechanisms, Shigley J. E. and John Joseph Uicker, 2nd edition Mc Graw-Hill international edition.
2.	Theory of Machines, R.K. Bansal & J.S. Brar,5th edition, Laxmi publications(P) LTD, New Delhi.
3.	Theory of Machines, R.S.Kburmi & J.K.Gupta,14th edition, S Chand & CO Ltd Publisher.
4.	Mechanism and Machine Theory, J. S. Rao and R. V. Dukkipati, 2"d edition New Age International.
WEB RESOURCES	
1.	www.mekanizmalar.com
2.	www.museum.kyoto-u. ac.jp
3.	Makezine.com
4.	https://nptel.ac.in/courses/Webcourse-contents/IITDelhi/Kinematics%20of%20Machine/site/basic kinematics/ basickinematics08.htm
5.	https://nptel.ac.in/courses/112105236/21
6.	https://nptel.ac.in/courses/112105236/34

7.	https://nptel.ac.in/courses/112104121/ 5. https://nptel.ac.in/courses/112106137/pdf/2_1.pdf.

II year - II semester

THERMAL ENGINEERING – I

Course Category	PCC	**Course Code**	16ME4T11
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To make the student learn and understand the reasons and effects of various losses that occurs in the actual engine operation.
2.	To familiarize the student with the various engine systems along with their function and necessity
3.	To learn about normal combustion phenomenon and knocking in S.I. and C.I. Engines and to find the several engine operating parameters that affect the smooth engine operation.
4.	To make the student learn to perform testing on S.I and C.I Engines for the calculations of performance and emission parameters
5.	To make students learn about different types of compressors and to calculate power and efficiency of reciprocating compressors.
6.	To make students learn mechanical details, and to calculate power and efficiency of rotary compressors

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Recall various Air standard cycles and Understand losses in the actual cycle.	Remembering
CO2	Classify various Engines and Understand its components.	Understanding
CO3	Study knocking and Detonation and analyse various parameters associated with them.	Analyzing
CO4	Calculate and Analyse different parameters by testing the engines.	Applying

CO5	Explain the working of air compressor along with factors influencing its performance.	Understanding
CO6	Understand Rotary Compressors and Calculate the parameters effecting the performance.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	-	-	-	-	-	-	-	-	-	
CO2	3	3	3	3	-	1	-	-	-	-	-	-	-	2
CO3	3	3	3	3	1	-	2	-	3	3	-	3	-	-
CO4	3	3	3	3	2	1	1	-	-	-	-	-	3	2
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	1
CO6	3	3	3	3	-	-	-	-	-	-	-	-	3	1

COURSE CONTENT	
UNIT I	**Actual Cycles and their Analysis:** Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blowdown-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.
UNIT II	**I. C. ENGINES:** Classification - Working principles, Valve and Port Timing Diagrams, Engine systems – Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of wankle engine, principles of supercharging and turbo charging, DTSI technology.
UNIT III	**Combustion in S.I. Engines:** Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Type of Abnormal combustion, pre-ignition and knocking– Fuel requirements and fuel rating, anti-knock additives – combustion chamber – requirements, types. Combustion in C.I. Engines: Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.
UNIT IV	Measurement, Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.
UNIT V	COMPRESSORS – Classification –positive displacement and roto dynamic machinery – Power producing and power absorbing machines, fan, blower and compressor – positive displacement and dynamic types – reciprocating and rotary types. Reciprocating: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance, stage compression, under cooling, saving of work, minimum work condition for stage compression.
UNIT VI	Rotary (Positive displacement type): Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations. Dynamic Compressors: Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power. Axial Flow Compressors: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- pressure rise calculations – Polytropic efficiency.

TEXT BOOKS	
1.	I.C. Engines / V. GANESAN- TMH
2.	Heat engines, vasandani & Kumar publications Thermal
REFERENCE BOOKS	
1.	IC Engines – M.L. Mathur & R.P. Sharma – Dhanpath Rai & Sons
2.	I.C. Engines – Applied Thermo sciences – C.R. Ferguson & A.T. Kirkpatrick-2nd Edition Wiley Publications
WEB RESOURCES	
1.	https://nptel.ac.in/courses/112104033/
2.	https://nptel.ac.in/courses/112108148/
3.	http://nptel.ac.in/courses/112104113/

II year - II semester

PRODUCTION TECHNOLOGY

Course Category	PCC	**Course Code**	16ME4T12
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To make the students understand fundamentals of casting.
2.	To provide insight into sand casting and introduce other casting processes
3.	To impart fundamentals of gas welding and arc welding.
4.	To teach principles of advanced welding processes and their applications.
5.	To impart knowledge on bulk forming processes.
6.	To provide understanding the basics of powder metallurgy and processing of plastics.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Recall the basic concepts of casting.	Remembering
CO2	Classify the different casting process.	Understanding
CO3	Define the basic principles of arc welding.	Remembering
CO4	Recall the advanced welding process.	Remembering
CO5	Choose forming processes based on requirement.	Applying
CO6	Tell about the basics of powder metallurgy and processing of plastics.	Remembering

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	-	1	-	-	-	-	-	1	-	-
CO2	2	2	1	1	1	-	-	-	-	-	-	-	-	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO4	3	2	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	1	2	2	1	-	-	-	-	-	-	-	-	-
CO6	2	1	1	2	1	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**CASTING:** Steps involved in making a casting – Advantage of casting and its applications. – Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Principles of Gating, Gating ratio and design of Gating systems.
UNIT II	Methods of melting and types of furnaces, Solidification of castings, Solidification of pure metals and alloys, short & long freezing range alloys. Risers – Types, function and design, casting design considerations, Basic principles and applications of Centrifugal casting, Die casting and Investment casting.
UNIT III	**Welding:** Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, Manual metal arc welding, Sub merged arc welding, Inert Gas welding- TIG & MIG welding.
UNIT IV	Resistance welding, Solid state welding processes- Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma welding, Laser welding, electron beam welding, Soldering & Brazing. Heat affected zones in welding; pre & post heating, Weldability of metals, welding defects – causes and remedies – destructive and nondestructive testing of welds, Design of welded joints.
UNIT V	Plastic deformation in metals and alloys, Hot working and Cold working, Strain hardening and Annealing. Bulk forming processes: Forging - Types Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing. Introduction to powder metallurgy – compaction and sintering, advantages and applications.
UNIT VI	Sheet metal forming - Blanking and piercing, Forces and power requirement in these operations, Deep drawing, stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools. Processing of Plastics: Types of Plastics, Properties, Applications and their processing methods, Blow and Injection molding.

TEXT BOOKS	
1.	Manufacturing Processes for Engineering Materials - Kalpakjian S and Steven R Schmid- Pearson Publications, 5th Edn.

2.	Fundamentals of Modern Manufacturing - Mikell P Groover- Wiley publications – 3rd Edition.
3.	Introduction to basic manufacturing processes and workshop technology-Rajinder Singh- New Age International Publishers.
4.	Production Technology- R.K. Jain- Khanna
REFERENCE BOOKS	
1.	Manufacturing Science – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd.
2.	Process and materials of manufacture- Lindberg- PHI
3.	Manufacturing Technology -Vol I- P.N. Rao- TMH
4.	Production Technology-P C Sharma-S. Chand
5.	Manufacturing Processes- H.S. Shaun- Pearson
6.	Manufacturing Processes- J.P. Kaushish- PHI
WEB RESOURCES	
1.	http://nptel.ac.in/courses/112107145/4
2.	http://nptel.ac.in/courses/112107145/5
3.	http://nptel.ac.in/courses/112107145/7
4.	http://nptel.ac.in/courses/112107145/23#

II year - II semester

DESIGN OF MACHINE MEMBERS – I

Course Category	PCC	**Course Code**	16ME4T13
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	Engineering drawing	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To analyze the basic design concepts and standards of any mechanical component. Also the student can understand the design procedure and selection of material for a specific application. Apply failure theories in evaluating strength of machine elements.
2.	To analyze machine components subjected to static and variable loads.
3.	To introduce the basic principles for design of machine elements such as riveted joints, welded joints, bolted joints and Bolted joints.
4.	To understand various joints subjected to axial loading and design of shafts.
5.	To understand various shaft couplings subjected to torsion.
6.	To understand the behavior and design of springs at various loading conditions.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Design various components and select material for a specific application and standards.	Analyzing
CO2	Design a component when it is subjected to variable loads.	Analyzing
CO3	Understand various joints subjected to axial loading and design of shafts.	Understanding

CO4	Design joints such as keys and cotter joint and knuckle joints under various loading conditions. Analyze and design both hollow and solid shafts.	Analyzing
CO5	Design shaft couplings for various engineering applications.	Analyzing
CO6	Analyze the deformations of various springs at different loading conditions.	Analyzing

Contribution of Course Outcomes towards achievement of Program														
Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO5	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO6	3	2	1	1	1	-	-	-	-	-	-	-	1	-

COURSE CONTENT	
UNIT I	**INTRODUCTION:** General considerations in the design of Engineering Materials and their properties – selection – Manufacturing consideration in design, tolerances and fits – BIS codes of steels. **STRESSES IN MACHINE MEMBERS:** Simple stresses – combined stresses – Torsional and bending stresses – impact stresses- Various theories of failure under static load – factor of safety – design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations – static strength design based on fracture toughness.
UNIT II	**STRENGTH OF MACHINE ELEMENTS:** Stress concentration – theoretical stress concentration factor – fatigue stress concentration factor notch sensitivity – design for fluctuating stresses – Endurance limit – Estimation of endurance strength –Factor of safety for fatigue loading- Goodman‟s line – Soderberg‟s line – Modified Goodman‟s line.
UNIT III	Types of riveted heads and riveted joints- Lap Joint – Butt joint- Riveted joints–Design of joints with initial stresses – Welded joints- Strength of parallel fillet and Transverse fillet welded joints- Eccentric loading. Bolted joints – design of bolts with pre-stresses – design of joints under eccentric loading – locking devices – both of uniform strength, different seals. Caulking and Fullering.
UNIT IV	**KEYS, COTTERS AND KNUCKLE JOINTS:** Classification of Keys-Design of keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints-knuckle joints. **SHAFTS:** Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads – shaft sizes – BIS code. Use of internal and external circlips, gaskets and seals (stationary & rotary).
UNIT V	**SHAFT COUPLING:** Types of shaft couplings-Rigid couplings – muff, split muff and flange couplings, flexible couplings – flange coupling (modified).
UNIT VI	**MECHANICAL SPRINGS:** Stresses and deflections of helical springs – extension - compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co-axial springs, leaf springs.

TEXT BOOKS	
1.	Design of Machine Elements by V.Bandari, TMH Publishers
2.	A Text Book of Machine Design by R.S Khurmi & J.K Gupta
3.	Machine design – Pandya & Shah
REFERENCE BOOKS	
1.	Design of Machine Elements / V.M. Faires
2.	Machine design / Schaum Series.
WEB RESOURCES	
1.	Design of Machine Elements / V.M. Faires
2.	Machine design / Schaum Series.
3.	Design of Machine Elements / V.M. Faires
4.	Machine design / Schaum Series.

II year - II semester

MACHINE DRAWING

Course Category	PCC	**Course Code**	16ME4T14
Course Type	Theory	**L-T-P-C**	3-3-0-3
Prerequisites	Engineering drawing	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To acquire knowledge of fastening arrangements such as welding, riveting the different styles of attachment for shaft. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.
2.	To provide basic understanding and drawing practice of various joint, simple mechanical parts Selection of Views, additional views for the following machine elements and parts with every drawing proportion.
3.	To be able to draw the assembly from the individual part drawing.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**Blooms Taxonomy Level**
CO1	Illustrate conventional representation of materials.	Understanding
CO2	Acquire the knowledge of various standards and specifications about standard machine components.	Understanding
CO3	Select, configure and synthesize mechanical components into assemblies.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	2	-	-	-	-	-	2	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2	2	-

CO3	3	-	-	-	-	-	-	-	-	-	-	2	2	-

COURSE CONTENT	
PART-A	**MACHINE DRAWING CONVENTIONS:** a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs, Symbols for weldments. b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned. c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features. d) Title boxes, their size, location and details - common abbreviations & their liberal usage. e) Types of Drawings – working drawings for machine parts. **Drawing of Machine Elements and simple parts:** a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws. b) Keys, cotter joints and knuckle joint. c) Rivetted joints for plates d) Shaft coupling, spigot and socket pipe joint. e) Journal, pivot and collar Pedestal Bearing (Plummer Block) and foot step bearings.
PART-B	**ASSEMBLY DRAWINGS:** **a) Engine parts:** - Stuffing box, - Cross heads, - Eccentrics, - Petrol Engine connecting rod, - Piston assembly. **b) Other machine parts:** - Screws jacks, - Machine Vices, - Single Tool post **c) Valves:** - Steam stop valve, - Spring loaded safety valve, - Feed check valve and

TEXT BOOKS	
1.	Machine Drawing – Dhawan, S.Chand Publications
2.	Machine Drawing –K.L. Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers.
3.	Machine Drawing including Auto CAD – Ajeet Singh/McGraw Hill Education
REFERENCE BOOKS	
1.	Machine Drawing – N.Siddeswar, K.Kannaiah & V.V.S.Sastry - TMH
2.	Machine Drawing – P.S.Gill,
3.	Machine Drawing – Luzzader
4.	Machine Drawing – Rajput
5.	Machine Drawing – N.D. Junnarkar, Pearson
6.	Machine Drawing – Ajeeth Singh, McGraw Hill

7.	Machine Drawing – KC John, PHI
8.	Machine Drawing – B Battacharya, Oxford
WEB RESOURCES	
1.	https://www.youtube.com/watch?v=Ss5nBSIr5MY
2.	https://www.youtube.com/watch?v=q3nS9FrDqH0
3.	https://www.youtube.com/watch?v=nnUTjSGEDGo
4.	https://www.youtube.com/watch?v=GD70UA5kjFc
5.	https://www.youtube.com/watch?v=rtdoqgysYMs

II year - II semester

INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Category	PCC	**Course Code**	16ME4T15
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To make students learn about management, organization principles and also motivational qualities and leadership qualities.
2.	To make students learn about where to and how to locate a plant, difficulties of plant layouts. Maintenance of a plant (organization)
3.	To make students learn about types of work studies and processing charts, job evaluating techniques.
4.	To make students learn about types of quality control charts and improvement of quality with analysis techniques
5.	To make students learn about industrial disputes and labor welfare
6.	To make students learn about enterprise planning and project management.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**Blooms Taxonomy Level**
CO1	Management, organization principles and also motivational qualities and leadership qualities.	Remembering
CO2	Where to and how to locate a plant, difficulties of plant layouts, Maintenance of a plant (organization).	Applying
CO3	Types of work studies and processing charts, job evaluating techniques.	Evaluating
CO4	Types of quality control charts and improvement of quality with analysis techniques.	Applying

CO5	Industrial disputes and labor welfare.	Remembering
CO6	Enterprise planning and project management.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	1	-	-	2	-	-	3	3	3	-	-	-
CO2	-	-	2	-	-	2	2	-	3	3	3	-	-	1
CO3	-	-	2	1	-	-	-	-	3	3	3	-	-	-
CO4	2	1	-	-	-	2	-	-	-	3	2	-	-	-
CO5	-	-	2	-	-	2	-	2	2	1	3	-	-	1
CO6	2	2	1	2	-	-	-	-	3	3	3	-	-	1

COURSE CONTENT	
UNIT I	**MANAGEMENT AND ORGANIZATION:** Definition – meaning and nature of management- Functions of management-Evolution of management thought- Taylor's Scientific management- Fayol's Principles of management- Basic concepts related to organization-Departmentation, Delegation and Decentralization, Type of organization structures- authority, responsibility and accountability **MOTIVATION THEORIES AND LEADERSHIP:** Definition, Meaning and Types of Motivation – Theories of Motivation-Douglas Mc Gregor Theory X and Theory Y, Mayo's Hawthorne Experiment- Herzberg two factor theory of motivation, Maslow's hierarchy of human needs Leadership: Definition, Meaning, Features and Types of Leadership (Autocratic, Democratic and Lassie Faire)
UNIT II	**PLANT LOCATION & LAYOUT:** Factors governing plant location, types of production layouts, comparison of rural and urban sites, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and breakdown maintenance, types of plant layout-various data analyzing forms-travel chart.
UNIT III	**OPERATIONS MANAGEMENT**: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.
UNIT IV	**STATISTICAL QUALITY CONTROL:** Quality control, its importance, SQC, attribute sampling inspection with single and double sampling, Control charts – $\bar{X}$ and R – charts $\bar{X}$ and S charts and their applications, numerical examples. **TOTAL QUALITY MANAGEMENT:** zero defect concept, quality circles, implementation, applications, ISO quality systems. Six sigma – definition, basic concepts

UNIT V	**INDUSTRIAL RELATIONS & LABOR WELFARE:** Definition of Industrial dispute – causes of Industrial dispute – (Internal & External) – machinery to solve industrial disputes, grievance management, attendance and leave, labor Act-2003, Factories Act-1948, workmen's Compensation Act- 1923. **RESOURCE MANAGEMENT:** Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, types. **Labor welfare:** Meaning- Statutory and Non-Statutory Act
UNIT VI	**VALUE ANALYSIS:** Value engineering, implementation procedure, enterprise resource planning and supply chain management. **PROJECT MANAGEMENT:** PERT, CPM – differences & applications, critical path, determination of floats, importance, project crashing, smoothing and numerical examples.

TEXT BOOKS	
1.	Industrial Engineering and management by O.P Khanna, Khanna Publishers.
2.	Industrial Engineering and Production Management, Martand Telsang, S.Chand & Company Ltd. New Delhi.
REFERENCE BOOKS	
1.	Industrial Management by Bhattacharya DK, Vikas publishers.
2.	Operations Management by J.G Monks, McGrawHill Publishers.
3.	Industrial Engineering by Banga & Sharma.
4.	Principles of Management by Koontz O‟ Donnel, McGraw Hill Publishers.
5.	Statistical Quality Control by Gupta.
6.	Industrial Engineering and Management by Raju, Cengage Publishers.
WEB RESOURCES	
1.	http://www.nptelvideos.in/2012/12/industrial-engineering.html
2.	http://nptel.ac.in/courses/112107143/1
3.	http://nptel.ac.in/courses/112107143/2
4.	http://nptel.ac.in/courses/112107143/3

5.	http://nptel.ac.in/courses/112107143/9
6.	http://nptel.ac.in/courses/112107143/10

II year - II semester

FLUID MECHANICS & HYDRAULIC MACHINES LAB

Course Category	Professional Core	**Course Code**	16ME4L04
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Select an appropriate pump/turbine with reference to given application/situation.	Evaluating
CO2	Estimate the optimum efficiency of a given pump/turbine under different load and (or) speed conditions.	Evaluating
CO3	Apply the fundamental principles of fluid mechanics in calculations involving basic flow measuring devices.	Applying
CO4	Estimate the forces developed by the jets on vanes and the major and minor losses of fluid flow through the pipes.	Evaluating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	3	-	-	3	3	-	-	-	-	-	3	-
CO2	3	-	-	2	-	-	-	-	-	-	-	-	3	-
CO3	-	3	3	-	-	-	2	-	-	-	-	-	3	-
CO4	-	-	3	-	-	3	3	-	-	-	-	-	3	-

LIST OF EXPERIMENTS:	
1.	Impact of jet on vanes
2.	Performance test on Pelton wheel-constant head
3.	Performance test on Pelton wheel-constant speed
4.	Performance test on Francis turbine-constant head
5.	Performance test on Francis turbine-constant speed
6.	Performance test on single stage centrifugal pump
7.	Performance test on multi stage centrifugal pump
8.	Performance test on Reciprocating pump
9.	Calibration of Venturi meter
10.	Calibration of Orifice meter
11.	Determination of Friction factor for a given pipe line

Note: Any 10 of the above 11 experiments are to be conducted.

II year - II semester

PRODUCTION TECHNOLOGY LAB

Course Category	PCC	**Course Code**	16ME4L05
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To impart hands-on practical exposure on manufacturing processes and equipment.

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Design and Apply the Casting fundamentals directly in the industry for preparation of complicated jobs.	Applying
CO2	Develop a product by using welding techniques and also Design weld joints that serve under different loading and servicing.	Applying
CO3	Apply the metal forming fundamentals and Plastic Processing Techniques for build a Product.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2	-	-	-	-	1	-	1	-	3	-
CO2	3	3	3	2	-	-	-	-	1	-	1	-	3	-
CO3	3	3	3	2	-	-	-	-	1	-	1	-	3	-

LIST OF EXPERIMENTS:	
	METAL CASTING
1.	Pattern Design and making - for one casting drawing.
2.	Sand properties testing - for strength and permeability
3.	Mould preparation, Melting and Casting

	WELDING
4.	Manual metal arc welding - Lap & Butt Joints
5.	Resistance Spot Welding
6.	Brazing and soldering
7.	Gas cutting
8.	TIG/MIG Welding
9.	Gas welding
	METAL FORMING AND POWDER METALLURGY
10.	Blanking & Piercing operations and study of simple, compound and progressive dies.
11.	Deep drawing and extrusion operations.
12.	Bending and other operations
13.	Basic powder compaction and sintering
	PROCESSING OF PLASTICS
14.	Injection Moulding
15.	Blow Moulding

NOTE: Each Trade should be minimum 2 Experiments and total will be 10 experiments.

III year - I semester

DYNAMICS OF MACHINERY

Course Category	PCC	**Course Code**	16ME5T16
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	Engineering mechanics	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To understand the effect of precession on the stability of moving vehicles and force analysis of planar mechanisms.
2.	To apply the knowledge of friction on clutches, brakes and dynamometers.
3.	To equip the knowledge of solving problems concerned with dynamic force analysis and concept of flywheel.
4.	To understand various types of governors.
5.	To impart the knowledge on balancing of rotary and reciprocating masses.
6.	To equip the knowledge on vibrations and their importance in design.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Analyze the stabilization of sea vehicles, air crafts and automobiles.	Analyzing
CO2	Apply the concept of friction on clutches, brakes and dynamometers.	Applying
CO3	Analyze the dynamic forces of slider crank mechanism and design of flywheel.	Analyzing
CO4	Compare the various governors and their mechanisms for controlling the speed of the engines.	Understanding

CO5	Analyze the balancing of rotary and reciprocating masses.	Analyzing
CO6	Analyze theeffect of vibration on beams and shafts with various load distributions.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3	2	3	-	3	-	2	-	-	-	2	-
CO2	2	2	3	2	-	-	-	-	2	2	-	-	1	2
CO3	1	1	3	1	2	-	-	-	3	2	-	-	1	1
CO4	2	-	3	2	-	-	-	-	1	2	-	-	2	-
CO5	2	-	3	-	-	-	-	-	2	2	-	-	1	2
CO6	3	2	3	2	3	-	-	-	3	2	2	-	2	-

COURSE CONTENT	
UNIT I	**INTRODUCTION:** Static and dynamic force analysis of planar mechanisms PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships. (Demonstration of models in video show).
UNIT II	**FRICTION-CLUTCHES:** Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, film lubrication. Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch. **BRAKES AND DYNAMOMETERS:** Simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.
UNIT III	**TURNING MOMENT DIAGRAMS:** Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.
UNIT IV	**GOVERNERS:** Watt, porter and proell governors, spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronism and hunting.
UNIT V	**BALANCING:** Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses. Analytical and graphical methods, unbalanced forces and couples – examination of "V" multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing, hammer blow, swaying couple, variation of tractive effort.
UNIT VI	**VIBRATIONS:** Free Vibration of spring mass system –Natural frequency-types of damping – damped free vibration, Simple problems on forced damped vibration, vibration isolation and transmissibility transverse loads, vibrations of beams with concentrated and distributed loads. Dunkerly's methods, Raleigh's method, whirling of shafts, critical speeds, torsional vibrations, two and three rotor systems.

TEXT BOOKS	
1.	Theory of Machines / S.S Rattan/ Mc. Graw Hill, 2014

2.	Mechanism and machine theory /Ashok G. Ambedkar/PHI Publications.
REFERENCE BOOKS	
1.	Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age
2.	Theory of Machines / Shigley / MGH
3.	Theory of Machines / Thomas Bevan / CBS Publishers
4.	Theory of machines / Khurmi/S.Chand.
WEB RESOURCES	
1.	https://www.youtube.com/watch?v=Ru2FnaHpr-4
2.	https://www.youtube.com/watch?v=FydJu1A1oeM
3.	https://www.youtube.com/watch?v=fEdz91oWrts
4.	https://www.youtube.com/watch?v=na90uKzc9JY
5.	http://nptel.ac.in/courses/112105164/16
6.	https://www.youtube.com/watch?v=FA04XFpJgwE
7.	http://nptel.ac.in/courses/112105124/40
8.	http://nptel.ac.in/syllabus/112104114/
9.	https://www.youtube.com/watch?v=ChN6yUzgBbs

III year - I semester

METAL CUTTING & MACHINE TOOLS

Course Category	PCC	**Course Code**	16ME5T17
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	Production technology	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To provide the fundamental knowledge and principles in material removal processes.
2.	To apply the fundamentals and principles of metal cutting to practical applications through machine tools.
3.	To demonstrate the fundamentals of machining processes and machine tools.
4.	To develop knowledge and importance of metal cutting parameters.
5.	To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
6.	To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Apply the fundamentals of metal removal processes, metal cutting forces and geometry of the cutting tools.	Applying
CO2	Explain the working principle, mechanism and various operations performed on lathe.	Understanding
CO3	Compare the mechanisms of shaper, slotter, planer and various operations performed by drilling and boring machines.	Analyzing
CO4	Explain the working principle of milling machines and its accessories.	Understanding

CO5	Summarize different finishing processes.	Evaluating
CO6	Design jigs and fixtures for simple parts; understand the working of CNC machines.	Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	1	-	-	3	1	-	-	1	2	2
CO2	2	1	1	-	1	-	-	3	1	-	-	1	2	2
CO3	2	1	1	-	1	-	-	3	1	-	-	1	2	2
CO4	2	1	1	1	1	-	-	3	1	-	-	1	2	2
CO5	2	1	-	-	1	-	-	3	1	-	-	1	2	2
CO6	2	1	2	-	2	-	-	3	1	-	-	2	2	2

COURSE CONTENT	
UNIT I	**FUNDAMENTALS OF MACHINING:** Elementary treatment of metal cutting theory – element of cutting process – geometry of single point cutting tool, tool angles, chip formation and types of chips-built up edge and its effects chip breakers, mechanics of orthogonal cutting – Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, tool wear, machinability, economics of machining, coolants, tool materials and properties.
UNIT II	**LATHE:** Engine lathe – principle of working, specification of lathe – types of lathe – work holders tool holders – box tools taper turning, thread turning – for lathes and attachments, constructional features of speed gear box and feed gear box. Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – single spindle and multi-spindle automatic lathes – tool layout and cam design for automats.
UNIT III	**SHAPING, SLOTTING AND PLANING MACHINES:** Principles of working – principal parts–specifications, operations performed, machining time calculations. DRILLING & BORING MACHINES: Principles of working, specifications, types, operations performed – tool holding devices types of drills – Boring Machines – fine Boring Machines – jig boring machine, deep hole Drilling Machine.
UNIT IV	**MILLING MACHINES:** Principles of working – specifications – classification of Milling Machines – Principle features of horizontal, vertical and universal Milling Machine, machining operations, types of cutters, geometry of milling cutters – methods of indexing, accessories to milling machines.
UNIT V	**FINISHING PROCESSES:** Theory of grinding – classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel. Lapping, Honing & Broaching operations, comparison to grinding.
UNIT VI	**JIGS & FIXTURES:** Principles of design of jigs and fixtures and uses, classification of jigs & fixtures, principles of location and clamping, types of clamping & work holding devices, typical examples of jigs and fixtures. **CNC MACHINE TOOLS:** CNC Machines, working principle, classification, constructional features of CNC machines, CNC controller, types of motion controls in CNC machines, applications of CNC machines.

TEXT BOOKS

1.	Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill
2.	Workshop Technology – B.S.RaghuVamshi – Vol II
3.	Production Engineering-P.C.Sharma, S.Chand & Company Ltd
4.	A text book of Manufacturing Technology (manufacturing Processes) by R.K.Rajput Lakshmi Publications(p) Ltd.
REFERENCE BOOKS	
1.	Metal cutting Principles by M.C. Shaw
2.	Metal cutting and machine tools /Geoffrey Boothroyd, Winston A.Knight/ Taylor & Francis
3.	Production Technology by H.M.T. (Hindustan Machine Tools).
4.	A text book of Production Engineering by K.C.Jain & A.K.Chaitale PHI learning Private Limited.
5.	Manufacturing Processes for Engineering Materials-Kalpakjian S & Steven R Schmid/Pearson Publications 5th Edition
WEB RESOURCES	
1.	**http://nptel.ac.in/courses/112105126/1**
2.	**http://nptel.ac.in/courses/112105126/5**
3.	**http://nptel.ac.in/courses/112105126/10**
4.	**http://nptel.ac.in/courses/112105126/25**

III year - I semester

DESIGN OF MACHINE MEMBERS –II

Course Category	PCC	**Course Code**	16ME5T18
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	DMM-I	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Various bearings and designing procedures.
2.	Design and analysis of the engine parts.
3.	Stresses induced in curved beams of various cross sections.
4.	Design and analysis of power screws.
5.	Power transmission through gears.
6.	Power transmission through pulleys and wire ropes.

By the end of the Course, the Student will be able to:

CO	**Description**	**Blooms Taxonomy Level**
CO1	Design the suitable bearing based on the application of the loads and predict the life of the bearing.	Analyzing
CO2	Design the engine parts like piston, cylinder, connecting rod and crankshaft.	Analyzing
CO3	Design the curved beams with different cross section.	Analyzing
CO4	Design of power screws.	Analyzing
CO5	Design the spur and helical gear drive for power transmission based on plastic deformation, dynamic and wear considerations.	Analyzing

CO6	Design power transmission elements such as belts, chains, pulleys and wire ropes.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3	1	2	1	-	-	-	-	-	1	1	1
CO2	2	-	3	1	1	-	-	-	-	-	-	-	2	-
CO3	3	1	3	1	1	-	-	-	-	-	-	-	1	-
CO4	3	2	3	2	1	-	-	-	-	-	-	-	2	-
CO5	2	1	3	2	3	-	-	-	-	-	-	-	1	2
CO6	2	1	3	2	1	-	-	-	-	-	-	-	2	1

COURSE CONTENT	
UNIT I	**BEARINGS:** Classification of bearings- applications, types of journal bearings – lubrication – Petroff's Equation– bearing modulus – full and partial bearings – clearance ratio – heat dissipation of bearings, bearing materials – journal bearing design – ball and roller bearings – static loading of ball & roller bearings, bearing life.
UNIT II	**ENGINE PARTS:** Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends – cranks and crank shafts - strength and proportions of over hung and center cranks – crank pins, crank shafts. Pistons, forces acting on piston – construction design and proportions of piston, cylinder, cylinder liners
UNIT III	Design of curved beams: introduction, stresses in curved beams, expression for radius of neutral axis for rectangular, circular, trapezoidal and T-section, design of crane hooks, C –clamps.
UNIT IV	**DESIGN OF POWER SCREWS**: Design of screw, square ACME, buttress screws, design of nut, compound screw, differential screw, Screw Jack.
UNIT V	**SPUR & HELICAL GEAR DRIVES:** Spur gears- helical gears – load concentration factor – dynamic load factor, surface compressive strength – bending strength – design analysis of spur gears – estimation of centre distance, module and face width, check for plastic deformation, check for dynamic and wear considerations.
UNIT VI	**POWER TRANSMISSIONS SYSTEMS:** Transmission of power by belt and rope drives, transmission efficiencies, belts – flat and v types – ropes - pulleys for belt and rope drives, materials, chain drives. Wire Ropes: Construction, Designation, Stresses in wire ropes, rope sheaves and drums.

TEXT BOOKS	
1.	Machine Design/V.Bandari/TMH Publishers 2015.
2.	Machine Design/T.V. Sundararajamoorthy/N. Shanmugam
3.	Design Data Book/PSG College of Technology 2012
4.	Machine Design Data Book by S.Md.Jalaludeen.

REFERENCE BOOKS	
1.	Machine Design: An integrated Approach / R.L. Norton / Pearson Education
2.	Mech. Engg. Design / JE Shigley/Tata McGraw Hill education
3.	Machine Design, Volume-1 & 2 by S.Md.Jalaludeen.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/112102015/28
2.	http://nptel.ac.in/courses/112104203/31
3.	http://nptel.ac.in/courses/112106137/25
4.	http://nptel.ac.in/courses/105106049/lecnotes/mainch10.html
5.	http://nptel.ac.in/courses/112105124/

III year - I semester

OPERATIONS RESEARCH

Course Category	PCC	**Course Code**	16ME5T19
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	Mathematics	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
To make the students learn about	
1.	Applications of operations research through LPP.
2.	Formulation of objective function through transportation and assignment problems.
3.	How to sequence the jobs and machines while processing and Replacement of machine/ equipment.
4.	How to calculate the optimal strategies of players and applications of waiting line problems.
5.	Deterministic and stochastic models.
6.	Applications of operations research through DPP and simulation techniques

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**Blooms Taxonomy Level**
CO1	Formulate the objective function by linear programming problem and solution through various models.	Applying
CO2	Evaluate optimal solutions to the objective function with the knowledge of transportation and assignment problems.	Applying
CO3	Apply the sequencing of the jobs on a machine and items replacements.	Analyzing

CO4	Analyze the best strategies and service rate.	Analyzing
CO5	Apply the inventory models in balancing the stock and demand ratio for profits.	Applying
CO6	Apply the principle of dynamic programming and simulation techniques.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	-	-	-	-	-	3	-	3	1
CO2	3	3	3	1	3	-	-	-	-	-	3	-	3	1
CO3	3	3	3	1	3	-	-	-	-	-	3	-	3	1
CO4	3	3	3	2	3	-	-	-	-	-	3	-	3	2
CO5	3	3	3	1	3	-	-	-	-	-	3	-	3	2
CO6	3	3	3	2	3	-	-	-	-	-	3	-	3	1

COURSE CONTENT	
UNIT I	**INTRODUCTION: Development** – definition– characteristics and phases – types of operation research models – applications. **ALLOCATION:** Linear programming problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle.
UNIT II	**TRANSPORTATION PROBLEM:** Formulation – optimal solution, unbalanced transportation problem – degeneracy, **ASSIGNMENT PROBLEM** – formulation – optimal solution - variants of assignment problem- travelling salesman problem.
UNIT III	**SEQUENCING** – Introduction – flow –shop sequencing –*n* jobs through two machines – *n* jobs through three machines – job shop sequencing – two jobs through 'm' machines. **REPLACEMENT:** Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.
UNIT IV	**THEORY OF GAMES:** Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method. **WAITING LINES:** Introduction – single channel – poison arrivals –exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.
UNIT V	**INVENTORY:** Introduction – single item – deterministic models –purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable – instantaneous production. Instantaneous demand and continuous demand and no set up cost. ABC & VED Analysis.

UNIT VI	**DYNAMIC PROGRAMMING:** Introduction – Bellman's principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem. **SIMULATION:** Definition – types of simulation models – phases of simulation– applications of simulation – inventory and queuing problems – advantages and disadvantages – simulation languages.

TEXT BOOKS	
1.	Operations Research / S.D.Sharma-Kedarnath
REFERENCE BOOKS	
1.	Operations Research / A.M.Natarajan, P. Balasubramani, A.Tamilarasi / Pearson Education.
2.	Operations Research / R.Pannerselvam,PHI Publications.
3.	Operations Research / Wagner/ PHI Publications.
4.	Operations Research/S Kalavathy / Vikas Publishers
5.	Operations Research / DS Cheema/University Science Press
6.	Operations Research / Ravindran, Philips, Solberg / Wiley publishers.
WEB RESOURCES	
1.	http://www.nptelvideos.in/2012/12/fundamentals-of-operations-research.html

III year - I semester

THERMAL ENGINEERING – II

Course Category	PCC	**Course Code**	16ME5T20
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	Thermodynamics Thermal Engineering-I	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Basic components being used in steam power plant cycles and also the methods to improve the efficiency of the cycle.
2.	Boilers, mountings and accessories being used in boilers and also the performance evaluation of boilers.
3.	Selecting appropriate nozzle for maximum mass flow rate and steam turbine.
4.	This unit is intended to provide basic knowledge of Steam Turbines and also its performance for maximum work output.
5.	Gas turbines, various methods to improve their performance.
6.	Basic principle for jet propulsion, rocket and their performance evaluation.

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**

CO1	Apply the knowledge of steam power plant cycles for the generation of power.	Applying
CO2	Summarize the working of various boilers and their performance.	Analyzing
CO3	Design a steam nozzle for maximum mass flow rate.	Analyzing
CO4	Evaluate steam turbines for better efficiency.	Analyzing
CO5	Evaluate gas turbines and various methods to improve performance.	Analyzing
CO6	Explain the working of jet propulsion and rocket engineering.	Applying

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	-	2	-	-	-	-	1	1	1	2
CO2	2	2	1	1	-	-	2	-	-	-	2	1	2	-
CO3	3	2	1	1	-	-	-	-	-	-	-	2	1	-
CO4	3	2	2	2	-	-	-	-	-	-	2	2	1	-
CO5	2	1	2	2	-	2	-	-	-	-	2	2	1	1
CO6	2	1	1	2	-	-	2	-	-	-	2	2	2	1

COURSE CONTENT	
UNIT I	**BASIC CONCEPTS:** Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating.
UNIT II	**BOILERS** : Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – draught, classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.
UNIT III	**STEAM NOZZLES:** Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line. **STEAM CONDENSERS**: Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump- cooling water requirement.
UNIT IV	**STEAM TURBINES:** Classification – impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-laval turbine - methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, velocity and pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency. Reaction Turbine**:** Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency – calculation of blade height.
UNIT V	**GAS TURBINES**: **GAS TURBINES:** Simple gas turbine plant – ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –closed and semi-closed cycles – merits and demerits, types of combustion chambers.

UNIT VI	**JET PROPULSION** Principle of operation –classification of jet propulsive engines – working principles with schematic diagrams and representation on T-S diagram - thrust, thrust power and propulsion efficiency – turbo jet engines – needs and demands met by turbo jet – schematic diagram, thermodynamic cycle, performance evaluation, thrust augmentation – methods. **Rockets:** Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines.

TEXT BOOKS	
1.	Thermal Engineering – R K Rajput-Lakshmi Publications.
2.	Gas Turbines – V.Ganesan /TMH
3.	Thermodynamics and Heat Engines, Volume 2 - R.Yadav- Central book depot.
REFERENCE BOOKS	
1.	Gas Turbines and Propulsive Systems – P.Khajuria & S.P.Dubey - /Dhanpatrai
2.	Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley– Longman
3.	Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.
4.	Thermal Engineering-P.L.Ballaney/ Khanna publishers.
5.	Thermal Engineering-M.L.Marthur & Mehta/Jain bros
6.	Heat Engineering – V.P Vasandani and D.S Kumar- Metropolitan Book Company, New Delhi
WEB RESOURCES	
1.	https://nptel.ac.in/courses/112103277/
2.	https://nptel.ac.in/courses/112107216/
3.	https://nptel.ac.in/courses/112107216/
4.	https://nptel.ac.in/courses/112107216/
5.	https://nptel.ac.in/courses/112107216/

III year - I semester

THEORY OF MACHINES LAB

Course Category	PCC	**Course Code**	16ME5L06
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	Kinematics of machinery, dynamics of machinery	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To impart practical knowledge of mechanisms for the types of motion in a machine; determine static and dynamic response of machine elements.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Blooms Taxonomy Level**
CO1	Understand the basic working of various linkages, mechanisms and machines.	Understanding
CO2	Analyze the vibrational behavior of systems.	Analyzing
CO3	Determine the principles of gyroscopes and Governors	Analyzing

CO4	Analyze the working phenomena of various machines.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	-	-	2	-	-	-	-	2	2	3	2
CO2	3	3	3	3	-	-	-	-	-	-	2	-	2	1
CO3	3	3	3	2	-	-	-	-	-	-	2	-	2	1
CO4	3	2	3	2	-	-	-	-	-	-	2	2	2	1

LIST OF EXPERIMENTS:	
1.	To determine whirling speed of shaft theoretically and experimentally.
2.	To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3.	To analyze the motion of a motorized gyroscope when the couple is applied along its spin axis.
4.	To determine the frequency of undamped free vibration of an equivalent spring mass system.
5.	To determine the frequency of damped force vibration of a spring mass system.
6.	To study the static and dynamic balancing using rigid blocks.
7.	To find the moment of inertia of a flywheel.
8.	To plot follower displacement Vs cam rotation for various Cam Follower systems.
9.	To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism.
10.	To find coefficient of friction between belt and pulley.
11.	To study simple and compound screw jack and determine the mechanical advantage, velocity ratio and efficiency.
12.	To study various types of gears- Spur, Helical, Worm and Bevel Gears.

Note: Any 10 of the above 12 experiments are to be conducted.

III year - I semester

MACHINE TOOLS LAB

Course Category	PCC	**Course Code**	16ME5L07
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	Production technology	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The students are required to understand the parts of various machine tools and operate them. They are required to understand the different shapes of products that can be produced on these machine tools.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**Blooms Taxonomy Level**
CO1	Demonstrate the knowledge of machining operations on Lathe for build a	Understanding

	product.	
CO2	Develop hands on knowledge and practical learning experience in shaping, slotting, drilling and tapping operations.	Applying
CO3	Develop skill in milling and grinding operations required for manufacturing industry.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	3	-	-	-	-	1	-	2	-	3	3
CO2	3	2	3	3	-	-	-	-	1	-	2	-	3	3
CO3	3	2	3	3	-	-	-	-	1	-	2	-	3	3

LIST OF EXPERIMENTS:	
1.	**Introduction of general-purpose machines** Lathe-Drilling Machine Milling Machine- Shaper Planning Machine Slotting Machine Tool and Cutter Grinder -Cylindrical grinder Surface Grinder.
2.	Plain turning and facing operations on lathe. (To be discussed).
3.	Step turning and taper turning operation on lathe.
4.	Thread cutting and knurling operation on lathe.
5.	Drilling operation on lathe.
Fundamental operations on	
6.	Drilling and tapping.
7.	Shaping and planning.
8.	Slotting.
9.	Milling.
10.	Cylindrical surface grinding.
11.	Grinding of tool angles.
12.	Introduction of CNC machine tools

Note: Any 10 of the above 11 experiments are to be conducted.

III year - I semester

THERMAL ENGINEERING LAB

Course Category	PCC	**Course Code**	16ME5L08
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	Thermodynamics, Thermal engineering-I & II	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To provide hands on experience in operating various types of internal combustion engines and understands their functioning and performance**.**

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Determine performance parameters of internal combustion engines, air	Applying

	compressors and refrigeration system.	
CO2	Estimate energy distributed by conducting heat balance test on IC engines.	Evaluating
CO3	Appreciate the Mechanism of ports/Valves functioning along with working of two stroke and four stroke SI and CI Engines.	Analyzing
CO4	Understand the sequence of operations to assemble/disassemble an IC engine & study the various processes associated with the performance of boilers.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	-	3	3	-	2	-	-	3	-	2
CO2	3	3	2	2	-	3	3	-	2	-	-	3	-	2
CO3	2	2	1	1	-	1	2	-	1	-	-	2	1	-
CO4	2	-	-	2	-	2	2	-	-	-	-	-	-	1

LIST OF EXPERIMENTS:	
1.	I.C. Engines valve / port timing diagrams.
2.	I.C. Engines performance test (4 -stroke diesel engines)
3.	I.C. Engines performance test on 2-stroke petrol.
4.	Evaluation of friction power by conducting Morse test on 4-stroke multi Cylinder petrol engine.
5.	Determination of friction power by retardation and motoring test on IC engine.
6.	I.C. Engines heat balance.
7.	Economical speed test of an IC engine.
8.	Performance test on variable compression ratio engines.
9.	Performance test on reciprocating air compressor unit.
10.	Study of boilers
11.	Dis-assembly / assembly of Engines.
12.	Load test on 4 - stroke single cylinder variable compression ratio petrol engine.
13.	Performance test on Refrigeration test rig.

Note: Any 10 of the above 13 experiments are to be conducted.

III year - I semester

INTELLECTUAL PROPERTY RIGHTS AND PATENTS

Course Category	HSMC	**Course Code**	16BH5T16
Course Type	Theory	**L-T-P-C**	0-2-0-0
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	
2.	

3.	
4.	
5.	
6.	

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Understand the basics of intellectual property rights	Understanding
CO2	Apply different pre-processing of copyright registration	Applying
CO3	Understand the basics of patents and patent rights and international patent law.	Understanding
CO4	Explore different types of trademarks with registration process	Understanding
CO5	Maintaining trade secrets with confidential agreements	Understanding
CO6	Understand cyber law with the help of information technology act 2000	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1	-	-	-	-	-	-	-	1	1	1
CO2	3	3	1	2	-	-	-	-	-	-	-	1	1	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO4	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO5	3	2	1	1	-	-	-	-	-	-	-	1	1	1
CO6	3	2	2	1	-	-	-	-	-	-	-	2	2	1

COURSE CONTENT	
UNIT I	Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics - Types of Intellectual Property - Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration –WTO-WIPO- Regulatory – Over use or Misuse of Intellectual Property Rights - Compliance and Liability Issues.
UNIT II	Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law- Semiconductor Chip Protection Act.
UNIT III	Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Product Patent and Process Patent- Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation –

	International Patent Law – Double Patenting – Patent Searching – New developments in Patent Law
UNIT IV	Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law.
UNIT V	Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation- Service Level Agreements – Breach of Contract – Applying State Law.
UNIT VI	Introduction to Cyber Law – Information Technology Act - Cyber Crime and E-commerce – Security -Data Security – Confidentiality – Data Privacy in India Vs Rest of the World. Relevant Cases Shall be dealt where ever necessary.

TEXT BOOKS	
1.	Prabhuddha Ganguli: 'Intellectual Property Rights" Tata Mc-Graw – Hill, New Delhi.
2.	Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
REFERENCE BOOKS	
1.	Deborah E.Bouchoux: "Intellectual Property". Cengage learning, New Delhi.
2.	Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
3.	Kompal Bansal & Parishit Bansal "Fundamentals of IPR for Engineers", BS Publications (Press).
4.	Cyber Law. Texts & Cases, South-Western's Special Topics Collections.

III Year – II Semester

METROLOGY

Course Category	PCC	**Course Code**	16ME6T21
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Basic knowledge of tolerance, limits and standard systems of the fits.

2.	Various measurements of standards, angle, and limit gauges.
3.	Various principles of measuring instruments and interference of light devices.
4.	Surface texture measurement and various types of comparators.
5.	Inspection of Spur Gear and thread elements.
6.	Machine tool testing to evaluate machine tool quality

By the end of the Course, the Student will be able to:		
CO	**Description**	**Blooms Taxonomy Level**
CO1	Design tolerances and fits for selected product quality.	Applying
CO2	Illustrate standards of length, angles and various types of limit gauges.	Analyzing
CO3	Choose appropriate method from various optical measuring instruments for inspection of surface flatness.	Applying
CO4	Evaluate surface finish and measure the parts with various comparators.	Remembering
CO5	Choose appropriate method and instruments for inspection of various gear elements and thread elements.	Applying
CO6	Evaluate the surface flatness and quality of the machine tool with alignment test.	Evaluating

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	-	-	1	-	-	1	-	-	1	1	-
CO2	1	-	-	-	-	1	-	1	1	-	-	2	1	-
CO3	1	-	-	1	-	1	-	-	-	1	-	-	1	-
CO4	1	1	-	1	2	-	-	-	1	-	-	-	1	-
CO5	1	1	-	1	-	-	-	-	1	1	1	-	-	-
CO6	-	-	-	2	1	1	-	1	1	1	1	-	-	-

COURSE CONTENT	
UNIT I	**SYSTEMS OF LIMITS AND FITS**: Introduction, nominal size, tolerance, limits, deviations, fits -Unilateral and bilateral tolerance system, hole and shaft basis systems-interchangeability, determistic & statistical tolerance, selective assembly. International standard system of tolerances, selection of limits and tolerances for correct functioning.
UNIT II	**LINEAR MEASUREMENT:** Length standards, end standards, slip gauges-calibration of the slip gauges, dial test indicators, micrometers. **MEASUREMENT OF ANGLES AND TAPERS:** Different methods – bevel protractor, angle slip gauges- angle dekkor- spirit levels- sine bar- sine table, rollers and spheres used to measure angles and tapers. **LIMIT GAUGES:** Taylor's principle – design of Go and No Go gauges; plug, ring, snap, gap, taper, profile and position gauges.

UNIT III	**Optical Measuring Instruments:** Tools maker's microscope and uses - autocollimators, optical projector, optical flats and their uses. **Interferometry:** Interference of light, Michelson's interferometer, NPL flatness interferometer, and NPL gauge interferometer.
UNIT IV	**Comparators:** Types - mechanical, optical, electrical and electronic, pneumatic comparators and their uses. **Surface Roughness Measurement:** Differences between surface roughness and surface waviness, Numerical assessment of surface finish-CLA, Rt., R.M.S. Rz, R10 values, Method of measurement of surface finish – Profilograph, Talysurf, ISI symbols for indication of surface finish.
UNIT V	**Gear Measurement:** Nomenclature of gear tooth, tooth thickness measurement with gear tooth vernier & flange micro meter, pitch measurement, total composite error and tooth to tooth composite errors, rolling gear tester, involute profile checking. **Screw Thread Measurement:** Elements of measurement – errors in screw threads-concept of virtual effective diameter, measurement of effective diameter, angle of thread and thread pitch, and profile thread gauges.
UNIT VI	**Flatness and Straightness Measurement:** Measurement of flatness of surfaces-instruments used- straight edges-surface plates. **Machine Tool Alignment Tests:** Principles of machine tool alignment testing on lathe, drilling and milling machines.

TEXT BOOKS	
1.	Engineering Metrology by R.K.Jain / Khanna Publishers
2.	Engineering Metrology by I.C.Gupta / Dhanpat Rai Publishers
REFERENCE BOOKS	
1.	Dimensional Metrology, Connie Dotson, Cengage Learning.
2.	Engineering Metrology by Mahajan / Dhanpat Rai Publishers
3.	Engineering Metrology by KL Narayana, Scitech publishers.
4.	A Text Book of Production Engineering, P.C. Sharma, S. Chand Pub.
5.	Engineering Metrology and Measurements by NV Raghavendra, L Krishna murthy, Oxford publishers.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/112106179/10
2.	http://nptel.ac.in/courses/112106179/17
3.	http://nptel.ac.in/courses/112106179/23
4.	http://nptel.ac.in/courses/112106179/31
5.	http://nptel.ac.in/courses/112106179/32
6.	http://nptel.ac.in/courses/112106179/35

III Year – II Semester

INSTRUMENTATION & CONTROL SYSTEMS

Course Category	Professional Core	**Course Code**	16ME6T22
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES

1.	To impart the knowledge of basic principles of measurement and displacement.
2.	To enable students, apply the principles of measuring temperature and pressure.
3.	To enable student, Measure level, flow, speed, acceleration and vibration with the help of suitable instruments.
4.	To make the student, identify the suitable instruments to measure stress and strain.
5.	To make the student, to choose the appropriate instruments to measure humidity level, force, torque and power.
6.	The student should be able to learn what are the control system and their purpose.

COURSE OUTCOMES

CO	Description	Blooms Taxonomy Level
CO1	Analyze the performance characteristics of the instrument and will choose the suitable instrument to measure displacement.	Analyzing
CO2	Select the appropriate instruments to measure temperature and pressure.	Understanding
CO3	Measure level, flow, speed, acceleration and vibration with the help of suitable instruments.	Applying
CO4	Identify the suitable instruments to measure stress and strain.	Understanding
CO5	Choose the appropriate instruments to measure humidity level, force, torque and power.	Understanding
CO6	Analyze the measuring system with the help of control systems.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	3	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	2	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	2	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	1	-	2	-	-	-	-	-	-	-	-	-	-
CO6	3	1	-	3	-	-	-	-	-	-	-	-	2	-

COURSE CONTENT

UNIT I	Definition – Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. definitions and basic concepts of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity. Dynamic performance characteristics – sources of error, classification and elimination of error. **Measurement of Displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.**
UNIT II	MEASUREMENT OF TEMPERATURE: Classification – ranges – various principles of measurement – expansion, electrical resistance – thermistor – thermocouple – pyrometers – temperature indicators. MEASUREMENT OF PRESSURE: Units – classification – different principles used.

	manometers, piston, bourdon pressure gauges, bellows – diaphragm gauges. low pressure **measurement – thermal conductivity gauges– ionization pressure gauges, mcleod pressure gauge, Knudsen gauge.**
UNIT III	MEASUREMENT OF LEVEL: Direct method – indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubler level indicators. FLOW MEASUREMENT: Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser doppler anemometer (LDA). MEASUREMENT OF SPEED : Mechanical tachometers – electrical tachometers – stroboscope, noncontact type of tachometer MEASUREMENT OF ACCELERATION AND VIBRATION: Different simple instruments– **principles of seismic instruments – vibrometer and accelerometer using this principle.**
UNIT IV	Stress Strain Measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.
UNIT V	MEASUREMENT OF HUMIDITY – Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter. MEASUREMENT OF FORCE, TORQUE AND POWER- Elastic force meters, load cells, torsion meters, dynamometers.
UNIT VI	ELEMENTS OF CONTROL SYSTEMS: Introduction, importance – classification – open and closed loop systems, servomechanisms–examples with block diagrams–temperature, speed & position control systems.

TEXT BOOKS	
1	Measurement Systems: Applications & design by D.S Kumar.
2	Mechanical Measurements / BeckWith, Marangoni,Linehard, PHI / PE
REFERENCE BOOKS	
1	Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh/ TMH.
2	Experimental Methods for Engineers / Holman.
3	Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4	Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH.
5	Mechanical Measurements by R.S. Sirohi and Radha Krishnan, Jain Publications, 2009.
WEB RESOURCES	
1	http://www.nptelvideos.in/2012/11/process-control-and-instrumentation.html
2	https://www.youtube.com/watch?v=jnY9T4Bf9h8
3	https://www.youtube.com/watch?v=YZxY9k3yHrw

III Year – II Semester

REFRIGERATION & AIR CONDITIONING

Course Category	Professional Core	**Course Code**	16ME6T23
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To impart basic knowledge of refrigeration, study air refrigeration cycles and aircraft refrigeration.
2.	To make students aware of vapour compression systems and usage of p-h charts.
3.	To study various components used in VCR systems and types of refrigerants.
4.	To make students aware of vapour absorption system and Steam jet refrigeration system.
5.	To impart knowledge of psychrometric properties, processes used in air-conditioning.
6.	To study requirements of human comfort and different components used in air conditioning systems**.**

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Demonstrate the importance of different refrigeration systems and air refrigeration systems in aircrafts.	Analyzing
CO2	Discuss about vapour compression refrigeration and its performance using p-h charts.	Understanding
CO3	Discuss about different components and refrigerants used in vapour compression refrigeration system.	Understanding
CO4	Explain about vapour absorption system and steam jet refrigeration systems.	Understanding
CO5	Perform cooling load calculations and select the appropriate process equipment for air-conditioning.	Applying
CO6	Demonstrate types of air conditioning systems.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	-	-	-	-	3	3	-	3	1
CO2	3	3	3	1	3	-	-	-	-	3	3	-	3	1
CO3	3	3	3	1	3	-	-	-	-	3	3	-	3	1
CO4	3	3	3	2	3	-	-	-	-	3	3	-	3	2
CO5	3	3	3	1	3	-	-	-	-	3	3	-	3	2
CO6	3	3	3	2	3	-	-	-	-	3	3	-	3	1

COURSE CONTENT	
UNIT I	**INTRODUCTION TO REFRIGERATION:** Necessity and applications –unit of refrigeration and C.O.P. **REFRIGERATION:** Mechanical refrigeration -types of ideal cycles of refrigeration air refrigeration: bell Coleman cycle - open and dense air systems – refrigeration systems used in air craft's and problems
UNIT II	Working principle and essential components of the plant – simple vapour compression refrigeration cycle – COP – representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.

UNIT III	**REFRIGERANTS** – Desirable properties – classification - refrigerants used - nomenclature – ozone depletion – global warming. **VCR SYSTEM COMPONENTS:** Compressors – general classification –comparison – advantages and disadvantages. condensers – classification – working principles evaporators – classification – working principles, expansion devices – types – working principles.
UNIT IV	**VAPOUR ABSORPTION SYSTEM:** Calculation of maximum COP –description and working of NH3 – water system and Li Br –water (Two shell & Four shell) System, principle of operation three fluid absorption system, salient features. **STEAM JET REFRIGERATION SYSTEM:** Working Principle and Basic Components **NON-CONVENTIONAL REFRIGERATION METHODS:** Principle and operation of (i)Thermoelectric refrigerator (ii) Vortex tube
UNIT V	**INTRODUCTION TO AIR CONDITIONING:** Psychometric properties &processes – characterization of sensible and latent heat loads — need for ventilation, consideration of infiltration – load concepts of RSHF, GSHF-problems, concept of ESHF and ADP temperature, PRAGATI ENGINEERING COLLEGE: SURAMPALEM (Autonomous) air conditioning load calculations .
UNIT VI	**HUMAN COMFORT:** Requirements of human comfort and concept of effective temperature comfort chart –comfort air conditioning – requirements of industrial air conditioning. **AIR CONDITIONING SYSTEMS:** Classification of equipment, filters, grills and registers, fans and blowers. heat pump – heat sources – different heat pump circuits.

TEXT BOOKS	
1.	C. P. Arora., Refrigeration and air conditioning
2.	Domkundwar, S. C. Arora, A Course in Refrigeration and Air conditioning, Dhanpatrai Publications, New Delhi, India.
REFERENCE BOOKS	
1.	Manohar Prasad, Refrigeration and Air conditioning, New Age international
2.	Refrigeration and Air Conditioning by R K Rajput, S K kataria& sons
3.	R. Dossat, Principles of Refrigeration - - Pearson
4.	Refrigeration and Air conditioning,R.S.khurmi
WEB RESOURCES	
1.	http://nptel.ac.in/courses/112106133/23
2.	http://nptel.ac.in/courses/112106133/28
3.	http://nptel.ac.in/courses/112106133/30
4.	http://nptel.ac.in/courses/11210133/31

III Year – II Semester

HEAT TRANSFER

Course Category	Professional Core	**Course Code**	16ME6T24
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	---	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	To learn the basic differential equations of heat transfer in various modes.
2.	To acquire the knowledge of heat transfer and temperature distribution of various fins.
3.	To understand dimensional analysis and its applications for developing semi empirical non-dimensional correlations.
4.	To apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient.
5.	To learn about boiling, condensation and the concepts of LMTD, NTU for heat exchangers
6.	To learn about the concepts of radiation heat transfer.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**Cognitive Level***
CO1	Analyze the basic heat transfer concepts and their practical relevance in planes, cylinders and spherical components.	Analyzing
CO2	Analyze the concepts of heat transfer and temperature distribution of various fins.	Analyzing
CO3	Demonstrate dimensional analysis and its applications for developing semi empirical non-dimensional correlations.	Applying
CO4	Analyze empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient.	Analyzing
CO5	Evaluate the performance of heat exchangers using LMTD, NTU.	Evaluating
CO6	Discuss the concepts of radiation heat transfer.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO2	1	3	1	-	-	-	-	-	-	-	-	-	1	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	3	3	2	-	-	-	-	-	-	-	-	2	-
CO5	1	2	-	-	-	-	-	-	-	-	-	-	2	-
CO6	1	3	-	-	-	-	-	-	-	-	-	-	1	-

COURSE CONTENT	
UNIT I	**INTRODUCTION:** Modes and mechanisms of heat transfer – basic laws of heat transfer –General discussion about applications of heat transfer. **CONDUCTION HEAT TRANSFER:** Fourier equation – general heat conduction equation in cartesian, cylindrical and Spherical coordinates. Steady, unsteady and periodic heat transfer – initial and boundary conditions. **ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER:** Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient –

	electrical analogy – critical radius of insulation-Variable thermal conductivity – systems with heat sources or heat generation.
UNIT II	Extended surface (fins) heat Transfer – long fin, fin with insulated tip and short fin, application to error measurement of temperature. **ONE DIMENSIONAL TRANSIENT CONDUCTION HEAT TRANSFER:** Systems with negligible internal resistance – significance of Biot and Fourier numbers - chart solutions of transient conduction systems.
UNIT III	**CONVECTIVE HEAT TRANSFER:** Classification of convective heat transfer – dimensional analysis as a tool for experimental investigation – Buckingham Pi Theorem for forced and free convection, application for developing semi – empirical non-dimensional correlation for convective heat transfer – Significance of non-dimensional numbers – concepts of continuity, momentum and Energy Equations.
UNIT IV	**FORCED CONVECTION** **EXTERNAL FLOWS:** Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -flat plates and cylinders. **INTERNAL FLOWS:** Concepts about hydrodynamic and thermal entry lengths – division of internal flow based on this –use of empirical relations for horizontal pipe flow and annulus flow. **FREE CONVECTION:** Development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for vertical plates and pipes.
UNIT V	**HEAT TRANSFER WITH PHASE CHANGE** **BOILING:** Pool boiling – regimes- calculations on nucleate boiling, critical heat flux and film boiling. **CONDENSATION:** Film wise and drop wise condensation –Nusselt's theory of condensation on a vertical plate- film condensation on vertical and horizontal cylinders using empirical correlations. **HEAT EXCHANGERS:** Classification of heat exchangers – overall heat transfer coefficient and fouling factor – concepts of LMTD and NTU methods – Problems.
UNIT VI	**RADIATION HEAT TRANSFER:** Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

DATA HAND BOOK	
1.	C.P. Kothandaraman and Subramanian Heat and Mass Transfer Data Book, New Age International Publications, 7th Edition, Reprint 2012.
TEXT BOOKS	
1.	R.C.Sachdeva -Fundamentals of Engineering Heat and Mass Transfer —New Age Intl. Publishers 2nd Edition, 2005.
2.	P.K.Nag, Heat and Mass Transfer- TMH 2nd Edition, 2007.
3.	Heat and Mass Transfer by R.K.Rajput, S.Chand Publications 3rd Edition.
REFERENCE BOOKS	
1.	J.P.Holman, Heat transfer - Tata McGraw-Hill, 9th Edition, 2010.

2.	Yunus. A. Cengel, Heat & Mass Transfer-A Practical Approach – Tata McGraw Hill, 4th Edition, 2012.
3.	P.S.Ghoshdastidar Heat Transfer - Oxford Higher Education 6th Edition 2011.
4.	C.P.Kothandaraman and Subramanian, Heat and Mass Transfer, New Age International Publications 7th Edition 2010.
WEB RESOURCES	
1.	www.nptelvideos.in/2012/11/heat-transfer.html
2.	https://youtu.be/qa-PQOjS3zA
3.	https://www.youtube.com/watch?v=qa-PQOjS3zA

III Year – II Semester

ENTREPRENEURSHIP
(OPEN ELECTIVE)

Course Category	Professional Core	**Course Code**	16BH6E01
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	
2.	
3.	
4.	
5.	
6.	

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1		
CO2		
CO3		
CO4		
CO5		
CO6		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

COURSE CONTENT	
UNIT I	
UNIT II	
UNIT III	
UNIT IV	
UNIT V	
UNIT VI	

TEXT BOOKS	
REFERENCE BOOKS	
WEB RESOURCES	

III Year – II Semester

DATABASE MANAGEMENT SYSTEMS (OPEN ELECTIVE)
(Common to Civil Engineering and Mechanical Engineering)

Course Category	Professional Core	**Course Code**	16CS6E04
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Provide students with necessary skills for designing and development of databases for real world applications.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Identify the role of Database Management System for maintenance of Databases.	Applying
CO2	Apply Relational Model to design and manipulate a Database.	Applying
CO3	Convert Entity relationship model into Relational Model.	Applying
CO4	Implement SQL for a given problem.	Creating
CO5	Design a Database using Normalization techniques.	Creating
CO6	Determine Database transactions as per concurrency and ACID properties.	Evaluating

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

COURSE CONTENT	
UNIT I	Database system, Characteristics (Database Vs File System), Database Users (Actors on Scene, Workers behind the scene), Advantages of Data base systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment.
UNIT II	**RELATIONAL MODEL:** Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Logical Data Base Design. **BASIC SQL:** Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations.
UNIT III	**Entity Relationship Model**: Introduction to ER Model, Data Base Design, Representation of entities, attributes, entity set, relationship, relationship set, Additional **Features of ER Model**: constraints, sub classes, super class, Strong and Weak entities, inheritance, specialization, generalization, Aggregation.
UNIT IV	**SQL**: Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, concepts of views, relational set operations.
UNIT V	**SCHEMA REFINEMENT (NORMALIZATION):** Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).
UNIT VI	**TRANSACTION MANAGEMENT AND CONCURRENCY CONTROL**: Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and save point. Concurrency control for lost updates, uncommitted data, inconsistent retrievals. Concurrency control with locking methods: lock granularity, lock types, two phase locking for ensuring serializability.

TEXT BOOKS	
1.	Database Management Systems", Raghuram Krishnan, Johannes Gehrke, TMH3rd edition, 2003.
2.	Database Management System", RamezElmasri, Shamkant B. Navathe, PEA, 6th edition, 2016.
REFERENCE BOOKS	
1.	Database System Concepts,Silberschatz, Korth, TMH, 5th edition, 2011.
2.	Introduction to Database Systems, C J Date, PEA, 8th edition, 2004.
3.	The Database book principles & practice using Oracle/MySql, NarainGehani, Silicon Press, 2011
WEB RESOURCES	
1.	http://nptel.ac.in/courses/106106093 (Prof. D. Janakiram, IIT, Madras).

III Year – II Semester

WASTE WATER MANAGEMENT
(OPEN ELECTIVE)

Course Category	Professional Core	**Course Code**	16CE6E01
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Enables the student to distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation.
2.	To impart knowledge on selection of treatment methods for industrial waste water.
3.	To know the common methods of treatment in different industries.
4.	To acquire knowledge on operational problems of common effluent treatment plant.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Analyze the industrial waste quantity and quality requirements.	Analyze
CO2	Identify the treatment methods for industrial wastewater	Applying
CO3	Know the basic theories of industrial waste water management.	Remembering
CO4	Decide the need of common effluent treatment plant for the industrial area in their vicinity	Evaluating
CO5	Examine the effects and treatment methods of liquid waste from the manufacturing industries	Apply
CO6	Examine the effects and treatment methods of liquid waste from the food industries.	Apply

Contribution of Course Outcomes towards achievement of Program														
Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

COURSE CONTENT	
UNIT I	**Industrial water Quantity and Quality requirements:** Boiler and cooling waters– Process water for Textiles, Food processing, Brewery Industries, power plants, fertilizers, sugar mills.
UNIT II	**Miscellaneous Treatment:** Use of Municipal wastewater in Industries – Advanced water treatment - Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, elutriation, Removal of Iron and Manganese, Removal of Colour and Odour.
UNIT III	**Basic theories of Industrial Wastewater Management:** Industrial waste survey - Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis - Civil Engineering Wastewater characterization-Toxicity of industrial effluents-Treatment of wastewater-unit operations and processes-Volume and Strength reduction-Neutralization – Equalization and proportioning- recycling, reuse and resources recovery.
UNIT IV	**Industrial wastewater disposal management:** discharges into Streams, Lakes and oceans and associated problems, Land treatment – Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastes- Effluent Disposal Method.
UNIT V	**Process and Treatment of specific Industries-1:** Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants.
UNIT VI	**Process and Treatment of specific Industries-2:** Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Tanneries, Sugar Mills, Distillers, Dairy and Food Processing industries, Pharmaceutical Plants.

TEXT BOOKS	
1.	Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, New Delhi.
2.	Industrial Wastewater Treatment by KVSG Murali Krishna.
3.	Industrial Wastewater treatment by A.D. Patwardhan, PHI Learning, Delhi.
4.	Wastewater Treatment for Pollution Control and Reuse, by Soli. J Arceivala, Shyam R Asolekar, Mc-Graw Hill, New Delhi; 3rd Edition.
REFERENCE BOOKS	
1.	Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc- GrawHill, Third Edition.
2.	Wastewater Engineering by Metcalf and Eddy Inc., Tata Mc- Grawhill Co., New Delhi.
3.	Wastewater Treatment- Concepts and Design Approach by G.L. Karia& R.A. Christian, Prentice Hall of India.
4.	Unit Operations and Processes in Environmental Engineering by Reynolds. Richard, Cengage Learning.
WEB RESOURCES	
1.	
2.	

III Year – II Semester

COMPUTER GRAPHICS
(OPEN ELECTIVE)

Course Category	Professional Core	**Course Code**	16CS6E05
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Understand the fundamental concepts and theory of computer graphics.
2.	Understand modeling, and interactive control of 3D computer graphics applications.
3.	The underlying parametric surface concepts be understood.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Interpret the fundamentals of computer graphics and working principles of input output devices.	Evaluating
CO2	Apply Algorithms for drawing line, circle and filling along with 2-D geometric transformations.	Applying
CO3	Select algorithm for clipping and viewport object representation relation to images displayed on screen.	Applying
CO4	Analyze representation of 3 dimensional objects.	Analyzing
CO5	Design of surface detection method by using invariant 3-D transformations.	Creating
CO6	Design of animation sequences using motion-oriented graphics.	Creating

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	3	2	-	-	-	-	-	-	-	1	-
CO2	2	2	1	3	3	-	-	-	-	-	-	-	1	1
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	2
CO4	3	2	2	2	2	-	-	-	-	-	-	-	1	1
CO5	3	3	3	3	3	-	-	-	-	-	-	-	2	2
CO6	3	3	3	3	3	2	2	-	-	-	-	-	2	2

COURSE CONTENT	
UNIT I	INTRODUCTION: Application areas of computer graphics, overview of graphic system, video- display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices.
UNIT II	OUTPUT PRIMITIVES: Points and lines, line drawing algorithms, mid-point circle algorithm, Filled area primitives: scan-line polygon fill algorithm, boundary-fill and flood-fill algorithm. 2-D GEOMETRICAL TRANSFORMATIONS: Translation, scaling, rotation, reflection and shear transformation matrix representations and homogeneous co-ordinates, composite transformations, transformations between coordinates.
UNIT III	2-D VIEWING: The viewing pipe-line, viewing coordinate reference frame, window to view- port co-ordinate transformations, viewing function, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland-Hodgeman polygon clipping algorithm.
UNIT IV	3-D OBJECT REPRESENTATION: spline representation, Hermite curve, Bezier curve and B- spline curve, Polygon surfaces, quadric surfaces.
UNIT V	3-D GEOMETRIC TRANSFORMATIONS: Translation, rotation, scaling,reflection and shear transformation and composite transformations. Visible surface detection methods: Classification, back-face detection, depth-buffer, scan-line, depth sorting.
UNIT VI	COMPUTER ANIMATION: Design of animation sequence, general computer animation functions, raster animation, computer animation language, key frame system, motion specification.

TEXT BOOKS	
1.	Computer Graphics C version, Donald Hearn and M. Pauline Baker, Pearson/PHI, 2nd edition, 2008.
2.	Computer Graphics Principles & practice, Foley, VanDam, Feiner and Hughes, Pearson Education, second edition in C,1997.
REFERENCE BOOKS	
1.	"Computer Graphics Second edition", Zhigandxiang, Roy Plastock, Schaum's outlines, Tata Mc-Graw hill 1stedition, 2006.
2.	"Procedural elements for Computer Graphics", David F Rogers, Tata Mc Graw hill, 2nd edition, 2011.
3.	"Principles of Interactive Computer Graphics", Neuman and Sproul, TMH, 1st edition, 1973.
4.	"Computer Graphics", Steven Harrington, TMH, 2nd edition, 1983.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/106106090/(Prof.SukhenduDas, IIT Madras)

III Year – II Semester

ROBOTICS
(OPEN ELECTIVE)

Course Category	Professional Core	**Course Code**	16ME6E01
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Robot applications, classifications, controlling systems and automation.
2.	Robot components, their architecture, work envelope and types of drive systems.
3.	Homogeneous transformations and Manipulator Kinematics of robots.
4.	Robotic arm motion by using Mathematical approach.
5.	Trajectory planning for a manipulator by avoiding obstacles and programming languages, software packages for path description to robots.
6.	Functioning of sensors, actuators and Robot applications in manufacturing.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Classify the coordinate systems and control systems of a robot.	Understanding
CO2	Explain the architecture of a robot.	Understanding
CO3	Analyze kinematics of a serial manipulator.	Analyzing
CO4	Analyze dynamics of serial manipulator.	Analyzing
CO5	Develop the trajectory planning algorithms using programming languages.	Applying
CO6	Illustrate the applications of robots in manufacturing, select the actuators and feedback components for a given robot application.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	_	_	_	_	2	_	_	_	3	_
CO2	3	3	2	2	_	_	_	_	2	_	_	_	3	_
CO3	3	3	2	2	_	_	_	_	2	_	_	_	3	_
CO4	3	3	2	2	_	_	_	_	2	_	_	_	3	_
CO5	3	3	2	2	_	_	_	_	2	_	_	_	3	_
CO6	3	3	2	2	_	_	_	_	2	_	_	_	3	_

COURSE CONTENT	
UNIT I	**Introduction:** Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.
UNIT II	**Components of the Industrial Robotics:** Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.
UNIT III	**Motion Analysis:** Homogeneous transformations as applicable to rotation and translation – problems. **Manipulator Kinematics:** Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.
UNIT IV	Differential transformations and manipulators , Jacobians–problems. Dynamics: Lagrange – Euler and Newton – Euler formulations – Problems.
UNIT V	General considerations in path description and generation Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion – Robot programming, languages and software packages-description of paths with a robot programming languages.
UNIT VI	**Robot actuators and Feedback components:** Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors. Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

TEXT BOOKS	
1.	Industrial Robotics / Groover M P /Pearson Edu.
2.	Robotics and Control / Mittal R K & Nagrath I J / TMH.
REFERENCE BOOKS	
1.	Robotics / Fu K S/ McGraw Hill.
2.	Robotic Engineering / Richard D. Klafter, Prentice Hall.
3.	Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science.
4.	Introduction to Robotics / John J Craig / Pearson Edu.
WEB RESOURCES	
1.	http://www.nptel.ac.in/courses/112101099/1#

III Year – II Semester

GREEN ENGINEERING SYSTEMS
(OPEN ELECTIVE)

Course Category	Professional Core	**Course Code**	16CE6E04
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The fundamental knowledge of solar radiation and solar energy collectors.
2.	The uses of solar energy and Wind Energy with respect to applications.
3.	The sources of biomass, geothermal and ocean energy conversion systems and their principles.
4.	Electrical and mechanical energy efficient systems.
5.	Sustainable manufacturing processes
6.	Green buildings and Environmentally friendly building materials.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Demonstrate the solar radiation and explain different solar energy collectors.	Understanding
CO2	Explain the use of solar energy and Wind Energy components used in the energy production with respect to applications.	Understanding
CO3	Compare the biomass, geothermal and ocean energy conversion systems and their principles.	Understanding
CO4	Illustrate the principles of electrical and mechanical energy efficient systems.	Understanding
CO5	Explain the concept of sustainable manufacturing processes.	Understanding
CO6	Explain the concept of green buildings and environmentally friendly building materials.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	-	1	-	-	-	-	-	1	1	1
CO2	2	2	1	1	1	-	-	-	-	-	-	-	1	1
CO3	3	1	1	1	1	-	-	-	-	-	-	-	1	1
CO4	3	2	2	2	1	-	-	-	-	-	-	-	1	1

CO5	2	1	2	2	1	-	-	-	-	-	-	-	1	1
CO6	2	1	1	2	1	-	-	-	-	-	-	-	1	1

COURSE CONTENT	
UNIT I	SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells, I-V characteristics. SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.
UNIT II	SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney. WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.
UNIT III	BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation and economic aspects. GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.
UNIT IV	ENERGY EFFICIENT SYSTEMS: ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management. MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps.
UNIT V	ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

UNIT VI	GREEN BUILDINGS: Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings. Energy management.

TEXT BOOKS	
1.	Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH
2.	Non-Conventional Energy Resources/ Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3.	Green Manufacturing Processes and Systems, Edited / J. Paulo Davim/Springer 2013
REFERENCE BOOKS	
1.	Alternative Building Materials and Technologies / K.S Jagadeesh, B.V Venkata Rama Reddy and K.S
2.	Nanjunda Rao/New age international
3.	Principles of Solar Engineering / D.Yogi Goswami, Frank Krieth & John F Kreider / Taylor & Francis
4.	Non-Conventional Energy / Ashok V Desai /New Age International (P) Ltd
5.	Renewable Energy Technologies /Ramesh & Kumar /Narosa
6.	Non-conventional Energy Source/ G.D Roy/Standard Publishers
7.	Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd

III Year – II Semester

HEAT TRANSFER LAB

Course Category	Professional Core	**Course Code**	16ME6L09
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	Heat transfer (Theory)	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The laboratory course is aimed to provide the practical exposure to the students with regard to the determination of amount of heat exchange in various modes of heat transfer including condensation & boiling for several geometries.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Perform steady state conduction experiments to estimate thermal conductivity &Overall heat transfer coefficient of different materials.	Understanding
CO2	Estimate Heat transfer coefficients in forced convection, free convection, condensation and correlate with theoretical values.	Analyzing
CO3	Obtain variation of temperature along the length of the pin fin under forced conditions and Compare Heat pipe performance with existing pipes.	Applying
CO4	Perform Radiation experiments: Determine Surface emissivity of a test plate and Stefan-Boltzman constant.	Applying
CO5	Determine thermal properties and performance of Heat exchanger.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	2	-	-	-	-	-	-	-	-	2	1
CO2	2	1	2	2	-	-	-	-	-	-	-	-	2	1
CO3	2	1	2	2	-	-	-	-	-	-	-	-	2	1
CO4	2	1	2	2	-	-	-	-	-	-	-	-	2	1
CO5	2	1	2	2	-	-	-	-	-	-	-	-	2	1

LIST OF EXPERIMENTS:	
1.	Determination of Overall heat transfer co-efficient Composite Slab Apparatus
2.	Determination of Heat transfer through a lagged pipe.
3.	Determination of Heat Transfer through a Concentric Sphere
4.	Determination of Thermal Conductivity of given metal rod.
5.	Determination of Heat transfer in pin-fin
6.	Determination of Heat transfer in forced & natural convection apparatus.
7.	Determination of Parallel and counter flow heat exchanger.
8.	Determination of Emissivity of a given surface .
9.	Determination of Stefan Boltzmann constant.

10.	Determination of Heat transfer in drop and film wise condensation.
11.	Determination of Critical Heat flux.
12.	Study of heat pipe and its demonstration.
13.	COP of VCR System with Capillary and thermal expansion valve.
14.	Determination of thermal conductivity of liquids and gases.

Note: *Any 10 experiments are to be conducted among 14.*

III Year – II Semester

METROLOGY & INSTRUMENTATION LAB

Course Category	Professional Core	**Course Code**	16ME6L10
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	**METROLOGY:** The Metrology and instrumentation Laboratory course is designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements. The student can learn the measurements with and calibration of instruments. They also understand the machine tool alignment test.
2.	**INSTRUMENTATION:** Instrumentation lab introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, vibration etc.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Demonstrate the use of instruments for measuring linear (internal and external), angular dimensions and surface roughness.	Understanding
CO2	Demonstrate the measure of angle by sine bar and universal bevel protractor.	Understanding
CO3	Demonstrate the use of instruments of measuring pressure, flow, speed, displacement, temperature.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	-	-	3	-	-	-	-	-	2	3	3
CO2	2	3	3	-	-	3	-	-	-	-	-	2	3	3
CO3	3	3	3	-	-	3	-	-	-	-	-	2	3	3

LIST OF EXPERIMENTS:	
METROLOGY:	
1.	Measurement of lengths, heights, diameters by vernier calipers, micrometers, slip gauges etc.
2.	Measurement of bores by internal micrometers and dial bore indicators.
3.	Use of gear tooth vernier caliper for tooth thickness inspection and flange micro meter for checking the chordal thickness of spur gear.

4.	Machine tool alignment test on the lathe.
5.	Machine tool alignment test on drilling machine.
6.	Machine tool alignment test on milling machine.
7.	Angle and taper measurements with bevel protractor, Sine bars, rollers and balls.
8.	Use of spirit level in finding the straightness of a bed and flatness of a surface.
9.	Thread inspection with two wire/ three wire method & tool makers microscope.
10.	Surface roughness measurement with roughness measuring instrument.
INSTRUMENTATION:	
1.	Calibration of pressure gauge.
2.	Calibration of transducer for temperature measurement.
3.	Study and calibration of LVDT transducer for displacement measurement.
4.	Calibration of strain gauge.
5.	Calibration of thermocouple.
6.	Calibration of capacitive transducer.
7.	Study and calibration of photo and magnetic speed pickups.
8.	Calibration of resistance temperature detector.
9.	Study and calibration of a rotameter.
10.	Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11.	Study and calibration of Mcleod gauge for low pressure.

Note: *Any 6 experiments are to be conducted among 11.*

III Year – II Semester

PROFESSIONAL ETHICS AND HUMAN VALUES

Course Category	Professional Core	**Course Code**	16BH6T17
Course Type	Theory	**L-T-P-C**	0-3-0-0
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	-- -- --

COURSE OBJECTIVES	
1.	To impart knowledge on different concepts in professional ethics and human values, Practical Issues of Business Ethics in Various Functional Areas and other concepts
2.	To impart knowledge on meaning, purpose, professional roles, and different ethical theories in engineering ethics
3.	To impart knowledge on do standard experiments, accountability, ethical codes and experimental nature in social experimentation).
4.	To impart knowledge on concept of safety, risk, different types of risks, designing for safety, risk benefit analysis and accidents)
5.	To impart knowledge on engineer's rights and responsibilities, whistle blowing, differentiate between professionalism and loyalty and confidential and proprietary information along with collective bargaining and impact of bribe sand gifts on ethical behavior.
6.	To impart knowledge on the concept of globalization, computer ethics, and problems in research and intellectual property rights.)

COURSE OUTCOMES		
By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Understand different concepts in professional ethics and human values, Practical Issues of Business Ethics in Various Functional Areas and other concepts.	Understanding
CO2	Understand meaning, purpose, professional roles, and different ethical theories in engineering ethics	Understanding
CO3	Do standard experiments, accountability, ethical codes and experimental nature in social experimentation).	Applying
CO4	Understand concept of safety, risk, different types of risks, designing for safety, risk benefit analysis and accidents)	Analyzing
CO5	Understand engineer's rights and responsibilities, whistle blowing, differentiate between professionalism and loyalty and confidential and proprietary information along with collective bargaining and impact of bribes and gifts on ethical behavior.	Understanding
CO6	Understand the concept of globalization, computer ethics, and problems in research and intellectual property rights.)	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

COURSE CONTENT	
UNIT I	Professional Ethics and Human values: Ethics -History of Ethics-Types of Ethics, Professional Ethics and its forms -Significance-Personal ethics vs Professional Ethics, Morals, Values – Integrity – Work Place Ethics and Business Ethics –Ethics in HRM, Finance, Marketing Management – Civic Virtue –Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value time –Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.
UNIT II	Engineering Ethics: Engineering Ethics-Meaning & Purpose of Engineering Ethics-Consensus and Controversy –Profession, Professional and Professionalism –Key Characteristics of Engineering Professionals – Professional Roles to be played by an Engineer-Self Interest, Customs and Religion- Ethical Theories-Meaning & Uses of Ethical Theories-Types of Inquiry - Theories of moral Development-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.
UNIT III	Engineering as Social Experimentation: Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering- Ethical issues involved in Clinical Trials.
UNIT IV	Engineers' Responsibility for Safety and Risk: Concept of Safety-Types of Safety, Risk-Types of Risks, Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk-Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.
UNIT V	Engineers Responsibilities and Rights: Collegiality-Techniques for Achieving Collegiality – Loyalty -Two Senses of Loyalty-obligations of Loyalty-Misguided Loyalty – professionalism and Loyalty- Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems - Ethical egoism-Collective bargaining- Confidentiality-Acceptance of Bribes/Gifts when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies-Occupational Crimes-industrial espionage- price fixing-endangering lives- Whistle Blowing-types of whistle blowing-when should it be attempted-preventing whistle blowing.
UNIT VI	Global Issues: Globalization-Problems of globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics-computers as the instrument of Unethical behavior-computers as the object of Unethical Acts-autonomous computers-computer codes of Ethics-Weapons Development-Ethics and Research-Analyzing Ethical

	Problems in Research-Food and Drug Adulteration. Relevant case studies shall be dealt where ever necessary.

TEXT BOOKS	
1.	"Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2.	"Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana- Maruthi Publications.
REFERENCE BOOKS	
1.	"Professional Ethics and Human Values" by Prof.D.R.Kiran-
2.	"Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication
3.	"Ethics in Engineering" by Mike W. Martin and Roland Schinzinger -Tata McGraw- Hill - 2003
4.	"Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

IV Year – I Semester

MECHATRONICS

Course Category	Professional Core	**Course Code**	16ME7T25
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Frame of reference on mechatronic systems and their response.
2.	Functioning of solid state electronic devices.
3.	Overview of various actuating systems.
4.	Programming of microprocessors and microcontrollers in various fields.
5.	Overview of interfacing the system, data acquisition and signal conditioning in manipulation of analog signals.
6.	Emphasis of process controllers.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Demonstrate the mechatronic systems in various industrial fields.	Understanding
CO2	Functioning of solid-state electronic devices.	Understanding
CO3	Experiment with hydraulic and pneumatic actuating systems.	Applying
CO4	Measure physical quantities using digital electronics and systems.	Applying
CO5	Create system interfacing and data acquisition.	Analyzing
CO6	Design dynamic models using various responses.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	_	_	3	_	_	_	_	2	_	_	_	3	_
CO2	3	3	2	_	_	_	_	_	2	_	_	_	3	_
CO3	3	3	3	3	_	_	_	_	3	_	_	_	3	_
CO4	3	_	2	2	_	_	_	_	2	_	_	_	3	_
CO5	3	3	3	2	_	_	_	_	3	_	_	_	3	_
CO6	3	3	3	3	_	_	_	_	2	_	_	_	3	_

COURSE CONTENT	
UNIT I	Mechatronics systems – elements & levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.
UNIT II	Solid state electronic devices – PN junction diode, BJT, FET, DIAC, TRIAC and LEDs. Analog signal conditioning, operational amplifiers, noise reduction, filtering.
UNIT III	Hydraulic and pneumatic actuating systems – Fluid systems, Hydraulic systems, and pneumatic systems, components, control valves, electro- pneumatic, hydro-pneumatic, electro- hydraulic servo systems. Mechanical actuating systems and electrical actuating systems – basic principles and elements.
UNIT IV	Digital electronics and systems, digital logic control, microprocessors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.
UNIT V	System interfacing and data acquisition – Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing – data flow in DSPs, block diagrams, typical layouts, Interfacing motor drives.
UNIT VI	Dynamic models and analogies, System response. Process Controllers – Digital Controllers, Programmable Logic Controllers, Design of mechatronics systems & future trends.

TEXT BOOKS	
1.	MECHATRONICS Integrated Mechanical Electronics Systems/KP
2.	Ramachandran, GK Vijaya Raghavan & MS Balasundaram/WILEY India Edition.
REFERENCE BOOKS	
1.	Mechatronics – Smaili A, Mrad F, Oxford Higher Education, Oxford University Press.
2.	Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
3.	Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
4.	Mechatronics System Design / Devdas shetty/Richard/Thomson.
WEB RESOURCES	
1.	
2.	
3.	

4.	

IV Year – I Semester

CAD/CAM

Course Category	Engineering Science	**Course Code**	16ME7T26
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	Basic Design Knowledge using CAD Software	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Explain the fundamentals of CAD and outline the basic entities.
2.	Demonstrate the geometric modeling techniques
3.	Develop part programming for NC machines
4.	Classifying group technology and computer aided process planning.
5.	Illustrate quality control using computers.
6.	Classify manufacturing system integrated with computers.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Explain the fundamentals of CAD and outline the basic entities.	Understanding
CO2	Demonstrate the geometric modelling techniques.	Applying
CO3	Develop part programming for NC machines.	Applying
CO4	Explain about group technology and computer aided process planning.	Understanding
CO5	Illustrate quality control using computers.	Applying
CO6	Classify manufacturing system integrated with computers.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	-	2	-	-	-	-	2	-	-	2	2
CO2	3	2	3	-	3	-	-	-	-	3	-	-	2	1

CO3	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	3	2	2	-	-	-	-	-	-	-	2	-	1	2
CO5	3	2	1	3	-	-	-	-	-	-	-	-	2	2
CO6	3	2	2	2	-	-	-	-	-	2	-	-	2	2

COURSE CONTENT	
UNIT I	**Fundamentals of CAD:** Computers in industrial manufacturing, product cycle, CAD / CAM Hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, storage devices. **Computer Graphics:** Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.
UNIT II	**Geometric Modeling:** Requirements, geometric models, geometric construction models, Curve representation methods, surface representation methods, modeling facilities desired. Solid modeling - solid representation, boundary representation and constructive solid geometry **Drafting**: Basic geometric commands, layers, display control commands, editing, dimensioning.
UNIT III	**Part Programming for NC Machines:** NC, NC modes, NC elements, CNC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming. Direct Numerical Control, Adaptive Control.
UNIT IV	**Group Technology:** Part family, coding and classification, production flow analysis, types and advantages. **Computer Aided Processes Planning (CAPP)** – importance, types-Retrieval type CAPP system, Generative type CAPP system and Hybrid CAPP System, benefits of CAPP. FMS – Introduction, Equipment, Tool Management Systems, Layouts, FMS control.
UNIT V	**Computer Aided Quality Control:** Terminology used in quality control, use of computers in Quality control. Inspection methods- contact and noncontact types, Computer Aided Testing (CAT), integration of CAQC with CAD/CAM.
UNIT VI	**Computer Integrated Manufacturing Systems:** Types of manufacturing systems, machine tools and related equipment, material handling systems, material requirement planning, computer control systems, human labor in manufacturing systems, CIMS benefits.

TEXT BOOKS	
1.	CAD / CAM / CAE E Zimmers & M.Groover/Pearson Education
2.	Automation, Production systems & Computer integrated Manufacturing/ Groover/P.E
REFERENCE BOOKS	
1.	CAD / CAM Theory and Practice / Ibrahim Zeid / TMH.
2.	Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson.
3.	Computer Numerical Control Concepts and programming / Warren S Seames / Thomson.
4.	Product manufacturing and cost estimation using CAD/CAE/ Kuang Hua Chang, Elsevier Publishers.

WEB RESOURCES	
1.	https://www.tandfonline.com/doi/abs/10.1080/0951192X.2012.749527

IV Year – I Semester

FINITE ELEMENT METHODS

Course Category	Professional Core	**Course Code**	**16ME7T27**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	Strength of materials, heat transfer, matrix calculations.	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The basic principles of finite element analysis procedure.
2.	Concept of discretization and characteristics of finite elements that represent engineering structures.
3.	The analysis of trusses and beams.
4.	Analysis of 2-D problems.
5.	The use of higher order elements for 1-D and 2-D problems.
6.	To solve heat transfer and other field problems using FEM and FE procedure for dynamic analysis of structures.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Demonstrate the variational methods and weighted residual methods for solution to engineering problems.	Understanding
CO2	Explain the various steps in the procedure for FEM.	Understanding
CO3	Analyze the one-dimensional problems like trusses and beams by FEM	Analyzing
CO4	Simplify the 2-D problems using CST and axi-symmetric elements.	Analyzing
CO5	Examine the 1-D and 2-D using higher order elements.	Analyzing
CO6	Solve the heat transfer, torsional and free vibration problems	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	2	-	-	2	3	3
CO2	3	3	3	3	3	-	-	-	2	-	-	2	3	3
CO3	3	3	3	3	3	-	-	-	2	-	2	-	3	3

CO4	3	3	3	3	3	-	-	-	2	-	2	2	3	-
CO5	3	3	3	3	3	-	-	-	2	-	2	2	3	3
CO6	3	3	3	3	3	-	-	-	2	-	2	2	3	3

COURSE CONTENT	
UNIT I	Introduction to finite element method, stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, variational and weighted residual methods, concept of potential energy, one dimensional problems.
UNIT II	Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions.
UNIT III	Analysis of Trusses: Finite element modeling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations. Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.
UNIT IV	Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.
UNIT V	Higher order and isoparametric elements: One dimensional quadratic and cubic elements in natural coordinates, two dimensional four noded isoparametric elements and numerical integration.
UNIT VI	Steady state heat transfer analysis: one dimensional analysis of a fin and two-dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.

TEXT BOOKS	
1.	Introduction to Finite Elements in Engineering / Chandraputla, Ashok and Belegundu / Prentice – Hall.
2.	The Finite Element Methods in Engineering / SS Rao / Pergamon.
REFERENCE BOOKS	
1.	Finite Element Method with applications in Engineering / YM Desai, Eldho & Shah /Pearson publishers.
2.	An introduction to Finite Element Method / JN Reddy / McGrawHill.
3.	The Finite Element Method for Engineers – Kenneth H. Huebner, Donald L. Dewhirst, Douglas E.

	Smith and Ted G. Byrom / John Wiley & sons (ASIA) Pte Ltd.
4.	Finite Element Analysis: Theory and Application with Ansys, Saeed Moaveniu, Pearson Education.
WEB REFERENCES	
1.	http://web.mit.edu/kjb/www/Books/FEP_2nd_Edition_4th_Printing.pdf
2.	https://nptel.ac.in/courses/112104116/
3.	http://home.iitk.ac.in/~sbasu/me623_2006/fem_notes_me623.pdf
4.	http://mech.iust.ac.ir/files/mech/madoliat_bcc09/pdf/yijun_liu___nummeth_20040121_fem.pdf
5.	http://nptel.iitm.ac.in/video.php?courseId=1012
6.	http://www.finite-element-method.info/

IV Year – I Semester

POWER PLANT ENGINEERING

Course Category	Professional Core	**Course Code**	**16ME7T28**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1.	The course is aimed at providing knowledge of power generation through different prime movers viz steam, ICGT, Hydro, nuclear and hybrid systems along with their economics and environmental considerations.
2.	Student can learn about power generation through prime movers by using steam.
3.	Student can learn about power generation through prime movers by using Diesel and Gas energy
4.	Student can learn about power generation through prime movers by using hydro power and non conventional energy such as solar
5.	Student can able to understand the power generation through Nuclear Reactors.
6.	Student can able to understood the importance of economic and environmental considerations of power plants

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Explain the concepts of power generation through prime movers from steam.	Understanding
CO2	Classify the power plants and illustrate the construction.	Understanding
CO3	Illustrate different power plants (conventional) for generation of power.	Applying
CO4	Classify different reactors for power generation.	Understanding

CO5	Illustrate various instrumentation and operations related to power plants.	Applying
CO6	Estimate various costs related to the economics of power plants.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	1	-	-	-	1	-	-	-	-	-	2	-
CO5	3	2	1	-	-	2	2	3	-	-	-	2	2	-
CO6	2	2	-	3	3	2	3	3	3	-	2	3	2	3

COURSE CONTENT	
UNIT I	Introduction to the sources of energy – resources and development of power in india. **STEAM POWER PLANT:** Plant layout, working of different circuits, fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems. Combustion: properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, dust collectors, cooling towers and heat rejection. corrosion and feed water treatment.
UNIT II	**INTERNAL COMBUSTION AND GAS TURBINE POWER PLANTS:** **DIESEL POWER PLANT:** Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging. **GAS TURBINE PLANT:** Introduction – classification - construction – layout with auxiliaries, combined cycle power plants and comparison.
UNIT III	**HYDRO ELECTRIC POWER PLANT:** Water power – hydrological cycle / flow measurement – drainage area characteristics – hydrographs – storage and pondage – classification of dams and spill ways. **HYDRO PROJECTS AND PLANT:** Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants.
UNIT IV	**NUCLEAR POWER STATION:** Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation. **TYPES OF REACTORS:** Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.
UNIT V	**COMBINED OPERATIONS OF DIFFERENT POWER PLANTS:** Introduction, advantages of combined working, load division between power stations, storage type hydro-electric plant in combination with steam plant, run-of-river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, co-ordination of hydro- electric and gas turbine stations, co-ordination of hydro-electric and nuclear power stations, co-ordination of different types of power plants. POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements.

UNIT VI	**POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS**: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises. effluents from power plants and Impact on environment – pollutants and pollution standards methods of pollution control.

TEXT BOOKS	
1.	A course in Power Plant Engineering – Arora and Domkundwar, Dhanpatrai & Co.
2.	Power Plant Engineering – P.C.Sharma / S.K.Kataria Pub
REFERENCE BOOKS	
1.	Power Plant Engineering: P.K.Nag/ II Edition /TMH.
2.	Power station Engineering – ElWakil / McHill.
3.	An Introduction to Power Plant Technology / G.D. Rai.
WEB RESOURCES	
1.	https://onlinecourses.nptel.ac.in/noc20_me10/preview

IV Year – I Semester

COMPUTATIONAL FLUID DYNAMICS

(ELECTIVE -I)

Course Category	Professional Core	**Course Code**	**16ME7D01**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1.	*To learn fundamentals of numerical techniques and error estimation using computational methods.*
2.	*To learn the different methods to solve the system of simultaneous equations.*
3.	*To solve the conduction and convection heat transfer problems using finite difference methods.*
4.	*To learn the application of finite difference method to fluid flow problems.*
5.	*To learn the modeling of fluid flow.*
6.	*To learn finite volume method using various interpolations.*

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	*Interpret the effect number systems and its representation in error estimation.*	
CO2	*Demonstrate the different computational methods for solution to system of simultaneous equations.*	
CO3	*Recall the governing differential equations for fluid flow and heat*	

	transfer.	
CO4	*Explain the application of finite difference method to the solution of heat transfer.*	
CO5	*Explain the modeling of fluid flow.*	
CO6	*Explain the different interpolations and differentiation techniques in finite volume method.*	

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

COURSE CONTENT	
UNIT I	ELEMENTARY DETAILS IN NUMERICAL TECHNIQUES: Number system and errors, representation of integers, fractions, floating point arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, convergence of sequences.
UNIT II	APPLIED NUMERICAL METHODS: Solution of a system of simultaneous linear algebraic equations, iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices. REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, conservation of mass, Newton's second law of motion, expanded forms of navier- stokes equations, conservation of energy principle, and special forms of the navier-stokes equations.
UNIT III	Steady flow, dimensionless form of momentum and energy equations, stokes equation, conservative body force fields, stream function - vorticity formulation. Finite difference applications in heat conduction and convention – heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.
UNIT IV	Finite differences, discretization, consistency, stability, and fundamentals of fluid flow modelling: introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.
UNIT V	Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modelling, conservative property, the upwind scheme.
UNIT VI	FINITE VOLUME METHOD: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

TEXT BOOKS	
1.	Numerical heat transfer and fluid flow / Suhas V. Patankar/Butter-worth Publishers

2.	Computational fluid dynamics - Basics with applications /John. D. Anderson / Mc Graw Hill.
REFERENCE BOOKS	
1.	Computational Fluid Flow and Heat Transfer/ Niyogi/Pearson Publications
2.	Fundamentals of Computational Fluid Dynamics /Tapan K. Sengupta / Universities Press.
3.	Computational fluid dynamics: An introduction, 3rd edition/John.F Wendt/Springer publish
WEB RESOURCES	

IV Year – I Semester

CONDITION MONITORING

(ELECTIVE -I)

Course Category	Professional Core	**Course Code**	**16ME7D02**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	*Basics of Vibration in conditional monitoring.*
2.	*Techniques of vibration measurement and analysis.*
3.	*Fault diagnosis and some case studies for interpreting vibration measurement.*
4.	*Thermography and its applications in conditional monitoring*
5.	*Oil and wear debris analysis and its properties.*
6.	*Ultrasonic monitoring and analysis and study requirements.*

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Explain the concepts of Vibration, SDOF and MDOF systems.	Understanding
CO2	Analyze the vibrations using various techniques.	Analyzing

CO3	Interpret various faults in vibrations for diagnosis.	Applying
CO4	Inspect the equipment using thermography.	Evaluating
CO5	Analyze various properties of oil and wear particles by condition monitoring.	Analyzing
CO6	Examine the ultrasonic monitoring by testing and inspection.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	1	-	-	-	-	2	1
CO2	3	3	2	1	-	2	2	-	-	-	-	-	1	1
CO3	2	2	1	1	1	2	2	-	-	-	-	-	1	1
CO4	3	3	3	2	-	3	3	-	-	-	-	2	2	1
CO5	3	2	2	2	-	1	1	-	-	-	-	-	1	1
CO6	2	2	1	1	-	1	-	-	-	-	-	-	1	1

COURSE CONTENT	
UNIT I	BASICS OF VIBRATION: Basic motion: amplitudes, period, frequency, basic parameters: displacement, velocity, acceleration, units (including dB scales) and conversions, Mass, spring and damper concept, Introduction to SDOF and MDOF systems, Natural frequencies and resonance, Forced response.
UNIT II	VIBRATION MEASUREMENTS AND ANALYSIS: Transducers and mounting methods, data acquisition using instrumentation recorders/data loggers, time domain signal analysis, orbit analysis, Filters, Frequency domain analysis (Narrow band FFT analysis), Nyquist criteria, Sampling, aliasing, windowing and averaging. VIBRATION MEASUREMENT AND ANALYSIS: Use of phase; bode, polar and water fall plots, constant percentage band width analysis (1/3 and 1/1 Octave analysis), envelope detection/spike energy analysis, cepstral analysis, advances in analysis (PC based and portable instruments for vibration analysis).
UNIT III	Fault Diagnosis, Interpreting vibration measurements for common machine faults , imbalance, misalignment, mechanical looseness, bearing and gearing faults, faults in induction motors, resonances, some case studies, static and dynamic balancing, international standards for vibration condition monitoring.
UNIT IV	THERMOGRAPHY: The basics of infrared thermography, differences in equipment and specific wave length limitations, application of ir to: electrical inspection, mechanical inspection, energy conservation, how to take good thermal images, hands-on demonstrations focusing on proper camera settings and image interpretation, analysis of thermal images and report generation, study of thermo graphy applications
UNIT V	OIL AND WEAR DEBRIS ANALYSIS: Basics of oil analysis, monitoring condition of oil, lubricant analysis, physio – chemical properties, moisture, tan tbn, wear debris analysis, particle counting, spectroscopy, uses & limitations, ferrography wear particle analysis, concept of ferrography, principle particle classification, size, shape, composition, concentration, analysis procedure, sampling & analytical ferrography equipments, severity rating.

UNIT VI	ULTRASONIC MONITORING AND ANALYSIS: Ultrasonic monitoring (leak, crack and thickness) basics of ultrasonic monitoring , ultrasonic theory, test taking philosophy, ultrasonic theory, mathematics of ultrasound, equipment and transducers, inspection parameters and calibration, immersion theory, equipment quality control, flaw origins and inspection methods, UT Procedure familiarization, and study recommendations, application of ultrasound to: air leaks, steam trap testing, bearing lubrication, electrical inspection, case studies.

TEXT BOOKS	
1.	The Vibration Analysis Handbook, J I Taylor (1994)
2.	Machinery Vibration Condition Monitoring, Lynn, Butterworth(1989)
REFERENCE BOOKS	
1.	Machinery Vibration: Measurement and Analysis. Victor Wowk(1991).
2.	Mechanical fault diagnosis and condition monitoring, RA Collacott(1977).
3.	The Vibration Monitoring Handbook (Coxmoor's Machine & Systems Condition Monitoring) (1998).
4.	Condition monitoring of machinery by J.S.Rao, Narosa publishers,2013
WEB RESOURCES	
1.	http://nptel.ac.in/courses/112103112/40

IV Year – I Semester

ADDITIVE MANUFACTURING
(ELECTIVE -I)

Course Category	Professional Core	**Course Code**	**16ME7D03**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Additive manufacturing Technology in product development
2.	Concepts of solid-based rapid prototyping systems.
3.	Powder based additive manufacturing systems and 3D printing.
4.	Concepts of rapid and conventional tooling.
5.	Rapid prototyping data formats and features RP software's.
6.	Applications of additive manufacturing in various industries.

COURSE OUTCOMES	
By the end of the Course, the Student will be able to**:**	**BLOOMS TAXONOMY LEVEL**

CO1	Explain the importance of additive manufacturing in industrial growth.	Understanding
CO2	Develop the CAD models and make use of software for additive manufacturing.	Applying
CO3	Compare liquid and solid based additive Manufacturing systems.	Understanding
CO4	Inspect powder based additive manufacturing systems such as 3D printing, laser engineering net shaping and Electron Beam Melting.	Applying
CO5	Illustrate polymerization process, polymer processing and the significance for additive manufacturing.	Understanding
CO6	Elaborate the use of medical and bio-additive manufacturing and other the industrial applications.	Understanding

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO2	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO3	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO4	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO5	1	2	2	1	-	-	-	-	-	-	-	1	1	-
CO6	1	2	2	1	-	-	-	-	-	-	-	1	1	-

COURSE CONTENT	
UNIT I	**INTRODUCTION:** Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process. **LIQUID-BASED RAPID PROTOTYPING SYSTEMS:** Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.
UNIT II	**SOLID-BASED RAPID PROTOTYPING SYSTEMS:** Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.
UNIT III	**POWDER BASED RAPID PROTOTYPING SYSTEMS**: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. three-dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.
UNIT IV	**RAPID TOOLING:** Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.
UNIT V	**RAPID PROTOTYPING DATA FORMATS:** STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats.

	RAPID PROTOTYPING SOFTWARE'S: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.
UNIT VI	**RP APPLICATIONS:** Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bimolecular.

TEXT BOOKS	
1.	Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2.	Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.
REFERENCE BOOKS	
1.	Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
2.	Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. 3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.
WEB RESOURCES	
1.	nptel.ac.in/courses/112104204/47
2.	nptel.ac.in/courses/112107078/37
3.	nptel.ac.in/syllabus/112104156/

IV Year – I Semester

ADVANCED MATERIALS

(ELECTIVE -II)

Course Category	Professional Core	**Course Code**	**16ME7D04**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Basic understanding of composite materials and reinforcements.
2.	Detail explanation of different polymer composites and their applications
3.	Knowledge on manufacturing methods of composite materials.
4.	Detail explanation on laminates and its macro-mechanical analysis.
5.	Knowledge on FGM and shape memory alloys.
6.	Basic understanding of Nano materials and their applications.

COURSE OUTCOMES	
By the end of the Course, the Student will be able to**:**	**BLOOMS TAXONOMY LEVEL**

CO1	Explain the fundamentals of different composite materials.	Understanding
CO2	Classify different composite materials with their applications.	Understanding
CO3	Illustrate various manufacturing methods of composite materials.	Applying
CO4	Analyze macro-mechanical structure of a lamina.	Analyzing
CO5	Classify functionally graded materials and shape memory alloys.	Understanding
CO6	Illustrate Nano materials and their applications.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	-	-	-	-	-	-	-	-	-	-	1	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-	1	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-	2	-
CO6	1	2	2	1	1	-	-	-	-	-	-	-	2	-

COURSE CONTENT	
UNIT I	INTRODUCTION TO COMPOSITE MATERIALS: Introduction, classification: Polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiber- reinforced composites and nature-made composites, and applications. REINFORCEMENTS: Fibres- glass, silica, kevlar, carbon, boron, silicon carbide, and born carbide fibres.
UNIT II	Polymer composites, thermoplastics, thermosetting plastics, manufacturing of PMC, MMC & CCC and their applications.
UNIT III	MANUFACTURING METHODS: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.
UNIT IV	MACROMECHANICAL ANALYSIS OF A LAMINA: Introduction, generalized Hooke's law, reduction of Hooke's law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of an orthotropic lamina, laminate-laminate code.
UNIT V	FUNCTIONALLY GRADED MATERIALS: Types of functionally graded materials-classification-different systems-preparation-properties and applications of functionally graded materials. SHAPE MEMORY ALLOYS: Introduction-shape memory effect classification of shape memory alloys-composition-properties and applications of shape memory alloys.
UNIT VI	NANO MATERIALS: Introduction-properties at nano scales-advantages & disadvantages- applications in comparison with bulk materials (nano – structure, wires, tubes, composites). State of art nano advanced –topic delivered by student.

TEXT BOOKS	
1.	Nano material by A.K. Bandyopadyay, New age Publishers.
2.	Materials Science and Engineering: An Introduction - William D Callister Jr
3.	Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press.
REFERENCE BOOKS	
1.	R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2.	L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold.
3.	B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
4.	Mechanics of Composite Materials, Second Edition (Mechanical Engineering), Autar K.Kaw, Publisher: CRC.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/113105057/2
2.	http://www.nptelvideos.in/2012/12/advanced-materials-and-processes.html

IV Year – I Semester

DESIGN FOR MANUFACTURE
(ELECTIVE -II)

Course Category	Professional Core	**Course Code**	**16ME7D05**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Various steps in design processes and various effects on manufacturing processes.
2.	Rules in design processes and general recommendations for design of machine parts.
3.	Different Metal casting processes and general considerations for design of machine parts and assembly.
4.	Types of Metal joining processes and general guidelines for design of machining processes.
5.	Types of Metal forming processes and general guidelines for design of machining processes.
6.	Various non-metallic joining & forming processes and general guidelines for manufacturing processes.

COURSE OUTCOMES

By the end of the Course, the Student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	Illustrate design processes and effects on manufacturing process.	Analyzing
CO2	Design various components for machining.	Creating
CO3	Demonstrate metal casting.	Remembering
CO4	Summarize welding processes considering real time factors.	Understanding
CO5	Develop sheet metal work and extrusion process.	Applying
CO6	Design non-metallic component using plastics.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3	2	2	-	1	2	2	1	1	-	2	2
CO2	2	1	3	2	3	1	1	2	3	2	1	1	2	1
CO3	2	1	2	1	2	1	2	2	2	3	2	-	2	1
CO4	2	1	1	2	1	1	2	1	2	1	1	-	2	-
CO5	2	1	2	1	1	-	1	-	1	-	1	-	2	-
CO6	2	-	3	2	2	2	3	2	1	1	1	-	1	2

COURSE CONTENT	
UNIT I	Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design. Design for the life cycle total product life consumer goods –design considerations. Effect of manufacturing process on design, mechanisms selection, evaluation method.
UNIT II	Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining-ease-redesigning of components for machining ease with suitable examples. General design recommendations for machined parts. Design for economy - Design for accessibility.
UNIT III	Metal casting: Appraisal of various casting processes, selection of casting process, - general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting. Design for assembly method- Dewhurst DFA method.
UNIT IV	Metal joining: Appraisal of various welding processes factors in design of weldments– general design guidelines-pre and post treatment of welds- effects of thermal stresses in weld joints- design of brazed joints. Forging: Design factors for forging– closed die forging design– parting lines of dies– drop forging die design– general design recommendations.
UNIT V	Extrusion & Sheet metal work: Design guide lines extruded sections- design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram– component design for blanking.

UNIT VI	Non-Metallic Components Design: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding–design guidelines for machining and joining of plastics. Blow moulded, welded plastic articles, ceramics.

TEXT BOOKS	
1.	Design for Manufacture by Boothroyd Dewhurst
2.	Design for manufacture, Johncobert,AdissonWesley1995
3.	Design for manufacture, James Bralla
REFERENCE BOOKS	
1.	ASM HandbookVol.20
WEB RESOURCES	
1.	http://nptel.ac.in/syllabus/112101005/
2.	http://nptel.ac.in/syllabus/syllabus_pdf/112101005.pdf
3.	http://nptel.ac.in/courses/107103012/6
4.	http://nptel.ac.in/courses/112101005/

IV Year – I Semester

GAS DYNAMICS AND JET PROPULSION
(ELECTIVE -II)

Course Category	Professional Core	**Course Code**	**16ME7D06**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	*Basic concept of gas dynamics.*
2.	*The Isentropic flow fundamentals.*
3.	*The compressible flow with friction and heat transfer*
4.	*The application of normal shock in compressible flow.*
5.	*The thrust equation and its usage in jet aircraft.*
6.	*The aircraft propulsion systems and rocket propulsion and its applications*

COURSE OUTCOMES

By the end of the Course, the Student will be able to:		BLOOMS TAXONOMY LEVEL
CO1	*Explain basic concepts of gas dynamics.*	
CO2	*Analyze the steady one-dimensional isentropic flow.*	
CO3	*Interpret the flow properties in an isothermal flow with friction.*	
CO4	*Inspect the effect of heat transfer on flow parameters.*	
CO5	*Illustrate propulsion in various aircrafts.*	
CO6	*Evaluate the performance of rockets.*	

Contribution of Course Outcomes towards achievement of Program														
Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

COURSE CONTENT	
UNIT I	Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity - Mach number - classification of fluid flow based on mach number - mach cone- compressibility factor - general features of one-dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.
UNIT II	Isentropic flow of an ideal gas: basic equation - stagnation enthalpy, temperature, pressure and density-stagnation, acoustic speed - critical speed of sound- dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function. Steady one-dimensional isentropic flow with area change-effect of area change on flow parameters- chocking- convergent nozzle - performance of a nozzle under decreasing back pressure -De lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.
UNIT III	Simple frictional flow: adiabatic flow with friction in a constant area duct governing equation - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct governing equation - limiting conditions. Steady one-dimensional flow with heat transfer in constant area ducts governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy.
UNIT IV	Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

UNIT V	Propulsion: Air craft propulsion: - types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems.
UNIT VI	Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion - rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse - rocket engine performance - solid and liquid propellant rockets - comparision of various propulsion systems.

TEXT BOOKS	
1.	Fundamentals of compressible flow with aircraft and rocket propulsion- S. M. Yahya
2.	Compressible fluid flow - A. H. Shapiro.
3.	Fundamental of Gas dynamics, 2nd edition– Zucker- Wiley publishers.
REFERENCE BOOKS	
1.	Elements of gas dynamics - Liepman & Roshko.
2.	Aircraft & Missile propulsion - Zucrow.
3.	Gas dynamics - M.J. Zucrow & Joe D.Holfman.
WEB RESOURCES	
1.	https://youtu.be/_6796gj7-Gw
2.	https://youtu.be/lnViENuD8Ek
3.	https://youtu.be/lRS4EiNaTwg
4.	https://youtu.be/nw2rWNNmtl0
5.	https://youtu.be/i-7IivttOjY
6.	https://youtu.be/vKY9KJuFX9o

IV Year – I Semester

CAD/CFD LAB

Course Category	Professional Core	**Course Code**	**16ME7L11**
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
	CAD LAB
1.	To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's and various Finite Element Analysis tools.
	CFD LAB
2.	Solving Problems of fluid mechanics and heat transfer by writing programs in C- language and MATLAB.
3.	Using ANSYS-FLUENT build geometry, mesh that geometry, Perform CFD method on the mesh, perform the calculation, and post-process the results.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Utilize the CAD tools, 3D modelling software's and various Finite Element Analysis tools.	Applying
CO2	Solve the concept of CFD with different forms of equations.	Applying
CO3	Make use of appreciate the utility of the tools like ANSYS-FLUENT in solving real time problems and day to day problems.	Applying

Contribution of Course Outcomes towards achievement of Program

Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	-	-	-	2	-	-	-	3	3
CO2	3	3	3	2	3	-	-	-	2	-	-	-	3	3
CO3	3	3	3	2	3	-	-	-	2	-	-	-	2	2

LIST OF EXPERIMENTS:	
CAD LAB:	
1.	DRAFTING: Development of part drawings for various components in the form of orthographic and isometric representation of dimensioning and tolerances scanning and plotting. Study of script, DXE and IGES files.
2.	PART MODELING: Generation of various 3D models through protrusion, revolve, shell sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling surface and assembly modeling. Study of various standard translators. Design simple components. Generative drafting exercises.
3.	Import CAD model into analysis software and carry out the following:
	1. Determination of deflection and stresses in 2D and 3D trusses and beams.
	2. Determination of deflections component and principal and Von-mises stresses in plane stress, plane strain and Axisymmetric components.
	3. Determination of stresses in 3D and shell structures (at least one example in each case).
	4. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
	Steady state heat transfer Analysis of plane and Axisymmetric components
Packages to be provided to cater to drafting, modeling & analysis from the following: **Micro Station, CATIA, Pro-E, I-DEAS, ANSYS, NISA, CAEFEM, ABACUS etc.** **Total 6 experiments to be conducted from the above mentioned 3 experiments.**	
CFD LAB:	
PART-A	
1.	Solution of Transcendental equations.
2.	Solution of Simultaneous algebraic equations
3.	Numerical differentiation and Integration
4.	Solution of Ordinary Differential Equation

5.	Solution of a Tri-diagonal matrix using Thomas Algorithm.
6.	Solution of Partial differential equations related to
	1. Elliptical Partial differential equations
	2. Parabolic Partial differential equations
	3. Hyperbolic Partial differential equations
7.	Solution of 1-D and 2-D heat conduction with (Finite Difference method)
	1. Constant temperature boundary conditions
	2. Constant heat flux boundary conditions
	3. Convective boundary conditions
8.	Solution of Incompressible Navier-Stokes equations (Finite difference and Finite Volume methods)
9.	Solution of Inviscid incompressible fluid flows. (Finite difference and Finite Volume methods)
PART-B	
Using ANSYS-FLUENT solve the following problems of heat transfer analysis	
1.	Steady state conduction
2.	Lumped heat transfer
3.	Convective heat transfer – Internal flow (study both velocity and thermal boundary layers)
4.	Convective heat transfer – External flow (study both velocity and thermal boundary layers)
5.	Radiation heat transfer– Emissivity

Total 6 experiments to be conducted from any 3 experiments at each part.

IV Year – I Semester

CAM / MECHATRONICS LABORATORY

Course Category	Professional Core	**Course Code**	**16ME7L12**
Course Type	Laboratory	**L-T-P-C**	0-0-3-2
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
CAM LAB:	
1.	To impart knowledge on G-codes and M-codes for CNC programming and to know various tools to be used to improve the product in industries.
MECHATRONICS LAB:	
2.	To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic systems which enable the students to understand the concept of mechatronics.

COURSE OUTCOMES	
By the end of the Course, the Student will be able to**:**	**BLOOMS TAXONOMY**

		LEVEL
CO1	Develop CNC program for real time product manufacturing applications.	Applying
CO2	Develop PLC programs for real time applications like control of traffic lights, water level, and lifts.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	3	2	3	-	-	-	1	-	-	1	2	3
CO2	1	2	3	2	3	-	-	-	1	-	-	1	2	3

LIST OF EXPERIMENTS:	
CAM LAB:	
1.	Study of various post processors used in NC Machines.
2.	Machining of simple components on NC lathe and Mill by transferring NC Code / from a CAM package.
3.	CNC part programming Entry and Geometry.
4.	Practices on CNC Turning
	1. Programming for facing operation.
	2. Programming for Turning operation.
	3. Programming for Linear and Circular interpolation.
	4. Programming for Facing Cycle.
	5. Programming for Multiple Facing Cycle.
	6. Programming for Grooving Cycle.
5.	Practice on CNC Milling
	1. Programming using linear and circular interpolation.
	2. Programming using Sub-Program.
	3. Programming for Mirroring Operation.
	4. Programming for Circular Pocket Milling operation.
	5. Programming for Rectangular Pocket milling operation.
	6. Programming for Drilling Operation.

6.	Automated CNC Tool path & G-Code generation using Pro/E/Master CAM
Software's to be used: Micro Station,Gibbs CAM, Master CAM etc.	
MECHATRONICS LAB:	
1.	PLC PROGRAMMING
	1. Ladder programming on Logic gates ,Timers & counters
	2. Ladder Programming for digital & Analogy sensors
	3. Ladder programming for Traffic Light control, Water level control and Lift control Modules
2.	AUTOMATION STUDIO software
	1. Introduction to Automation studio & its control
	2. Draw & Simulate the Hydraulic circuit for series & parallel cylinders connection
	3. Draw & Simulate Meter-in, Meter-out and hydraulic press and clamping.
3.	MATLAB Programming
	1. Sample programmes on Matlab/SIMULINK
	2. Simulation and analysis of PID controller using SIMULINK

IV Year – II Semester

PRODUCTION PLANNING AND CONTROL

Course Category	Professional Core	**Course Code**	**16ME8T29**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	The concept of production and service systems.
2.	General principle techniques and types of forecasting.
3.	Concept of inventory management.
4.	Principles of routing and factors effecting routing.
5.	Different methods of scheduling and controlling aspects.
6.	Dispatching procedures and role of computer in production planning and control.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Demonstrate various production and service systems.	Applying

CO2	Summarize the concept of forecasting and their techniques.	Understanding
CO3	Recall the inventory management.	Understanding
CO4	Utilize routing procedure bill of material and scheduling processes.	Applying
CO5	Apply different scheduling and balancing techniques.	Applying
CO6	Explain dispatching procedure and role of computer in production planning and control.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	-	-	-	-	-	-	2	1	2	-
CO2	3	3	2	2	-	-	-	-	-	-	2	1	2	-
CO3	3	3	2	2	-	-	-	-	-	-	2	1	2	-
CO4	3	1	2	1	-	-	-	-	-	-	2	1	2	-
CO5	3	3	2	-	-	-	-	-	-	-	2	1	2	-
CO6	3	1	2	1	-	-	-	-	-	-	2	1	2	-

COURSE CONTENT	
UNIT I	Introduction: Definition – objectives and functions of production planning and control – elements of production control – types of production – organization of production planning and control department – internal organization of department.
UNIT II	Forecasting – importance of forecasting – types of forecasting, their uses – general principles of forecasting – forecasting techniques – qualitative methods and quantitative methods.
UNIT III	Inventory management – functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems. Introduction to MRP I, MRP II, ERP, LOB (Line of Balance), JIT and KANBAN system.
UNIT IV	Routing – definition – routing procedure –route sheets – bill of material – factors affecting routing procedure, schedule –definition – difference with loading.
UNIT V	Scheduling policies – techniques, standard scheduling methods. Line Balancing, aggregate planning, chase planning, expediting, controlling aspects.
UNIT VI	Dispatching – activities of dispatcher – dispatching procedure – follow up – definition – reason for existence of functions – types of follow up, applications of computer in production planning and control.

TEXT BOOKS	
1.	Elements of Production Planning and Control / Samuel Eilon.
2.	Manufacturing, Planning and Control, Partik Jonsson Stig-Arne Mattsson, Tata Mc Graw Hill.
REFERENCE BOOKS	

1.	Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.
2.	Production Planning and Control, Mukhopadyay, PHI.
3.	Production Control A Quantitative Approach / John E. Biegel.
4.	Production Control / Moore.
WEB RESOURCES	
1.	https://youtu.be/yYIVumq6sVM
2.	https://youtu.be/DVEbZFNRg
3.	https://youtu.be/k9dhcfIyOFc
4.	https://youtu.be/zlZaOnBbpUg
5.	https://youtu.be/Aw77aMLj9uM
6.	https://youtu.be/4oMmzCESLlY

IV Year – II Semester

UNCONVENTIONAL MACHINING PROCESSES

Course Category	Professional Core	**Course Code**	**16ME8T30**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	*The classification of unconventional machining processes.*
2.	*Mechanism of electro-chemical machining and different types of electro-chemical machining processes.*
3.	*Different machining processes based of thermal energy, he will also able to estimate the material removal rate.*
4.	*Laser Beam machining and its applications.*
5.	*Plasma machining process.*
6.	*Abrasive and water jet machining processes.*

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Explain the ultrasonic machining process and estimate the material removal rate in the process.	Understanding

CO2	Analyze the different electro-chemical machining process.	Analyzing
CO3	Examine the different process parameters for thermal metal removal processes.	Understanding
CO4	Explain the concept of electro-beam machining and Laser Beam machining process parameters its applications.	Understanding
CO5	Apply plasma for machining and its applications.	Applying
CO6	Build information about various machining processes based on input energy.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	-	1	-	-	-	2	-	-	-	-	1	1	-
CO3	2	-	1	-	-	-	-	-	-	-	-	1	3	-
CO4	2	-	-	-	-	-	-	-	-	-	-	1	3	-
CO5	2	-	-	-	-	-	2	-	-	-	-	1	2	-
CO6	2	-	-	-	-	-	2	-	-	-	-	1	2	-

COURSE CONTENT	
UNIT I	**INTRODUCTION:** Need for non-traditional machining methods-classification of modern machining process – considerations in process selection, applications. **Ultrasonic machining** – Elements of the process, mechanics of material removal, MRR process parameters, economic considerations, applications and limitations.
UNIT II	ELECTRO – CHEMICAL MACHINING: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and de-burring process, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate, fundamentals of chemical machining, advantages and applications.
UNIT III	**THERMAL METAL REMOVAL PROCESSES:** General principle and applications of Electric Discharge Machining, Electric Discharge Grinding and wire EDM – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface.
UNIT IV	Electron Beam Machining, Laser Beam Machining - Basic principle and theory, mechanics of material removal, process parameters, efficiency & accuracy, applications.
UNIT V	**Plasma Machining:** Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.
UNIT VI	Abrasive jet machining, Water jet machining and abrasive water jet machining: Basic principles, equipments, process variables, mechanics of material removal, MRR, application and limitations, magnetic abrasive finishing, abrasive flow finishing, Electro stream drilling, shaped tube electrolytic machining.

TEXT BOOKS

1.	Modern Machining Process / Pandey P.C. and Shah H.S./ TMH.
2.	Advanced machining processing- Vijaya.K.Jain/ Allied publications
3.	Advanced methods of machining-J.A.Mc.Geough/Springer publications
REFERENCE BOOKS	
1.	New Technology / Bhattacharya A/ the Institution of Engineers, India 1984.
2.	Non-Traditional Manufacturing Processes / Benedict
3.	Fundamentals of Machining Processes-Conventional and non – conventional processes/Hassan Abdel –Gawad El-Hafy/CRC Press-2016.
WEB RESOURCES	
1.	http://www.brainkart.com/article/Unconventional-machining-process_6332/
2.	http://nptel.ac.in/courses/112105126/36

IV Year – II Semester

AUTOMOBILE ENGINEERING

Course Category	Professional Core	**Course Code**	**16ME8T31**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Working of Automobile components.
2.	Working of Transmission systems.
3.	Types of steering mechanism, ignition systems and their working.
4.	Suspension, Breaking, Electrical systems and their working.
5.	Safety system in automobiles and specifications for engines
6.	Engine servicing and Emission standards in automobiles.

COURSE OUTCOMES	
By the end of the Course, the Student will be able to**:**	**BLOOMS TAXONOMY LEVEL**

CO1	Explain the working of Automobile components.	Understanding
CO2	Demonstrate the concept of transmission systems.	Understanding
CO3	Demonstrate the concept of steering mechanism.	Understanding
CO4	Apply concept of suspension system, braking system and electrical system.	Applying
CO5	Apply the engine specification and safety system.	Applying
CO6	Analyze the engine emission control and service.	Analyzing

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	-	1	1	1
CO2	3	3	1	2	-	-	-	-	-	-	-	1	1	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO4	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO5	3	2	1	1	-	-	-	-	-	-	-	1	1	1
CO6	3	2	2	1	-	-	-	-	-	-	-	2	2	1

COURSE CONTENT	
UNIT I	**INTRODUCTION:** Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, oil filters, oil pumps, air filters, **F**uel pump, nozzle, spray formation, injection timing, testing of fuel pumps, Types of carburetor – crank case ventilation – engine service, reboring, decarbonization, Nitriding of crank shaft.
UNIT II	**TRANSMISSION SYSTEM:** Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.
UNIT III	**STEERING SYSTEM:** Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages. **IGNITION SYSTEM:** Function of an ignition system, auto transformer, contact breaker points, condenser and spark plug –electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.
UNIT IV	**SUSPENSION SYSTEM:** Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system. **BRAKING SYSTEM:** Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes. **ELECTRICAL SYSTEM:** Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT V	**ENGINE SPECIFICATION AND SAFETY SYSTEMS:** Introduction-engine specifications with regard to power, speed, torque, no. of cylinders and arrangement. **SAFETY:** Introduction, safety systems - seat belt, air bags, bumper, anti-lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.
UNIT VI	**ENGINE EMISSION CONTROL:** Introduction – types of pollutants, mechanism of formation, concentration measurement, methods of controlling-engine modification, exhaust gas treatment- thermal and catalytic converters-use of alternative fuels for emission control – National and International pollution standards **ENGINE SERVICE:** Introduction, service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions.

TEXT BOOKS	
1.	Automotive Mechanics / Heitner
2.	Automobile Engineering / William Crouse, TMH Distributors .
3.	Automobile Engineering- P.S Gill, S.K. Kataria & Sons, New Delhi.
REFERENCE BOOKS	
1.	Automotive Engines Theory and Servicing, James D. Halderman and Chase D. Mitchell Jr., Pearson education inc.
2.	Automotive Engineering / Newton Steeds & Garrett.
3.	Automotive Mechanics – Vol. 1 & Vol. 2 / Kripal Singh, standard publishers.
WEB RESOURCES	
1.	https://www.youtube.com/watch?v=hs7bABMtOMI&list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MlJau4F

IV Year – II Semester

THERMAL EQUIPMENT DESIGN

(ELECTIVE -III)

Course Category	Professional Core	**Course Code**	16ME8D08
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	*Various types of heat exchangers and their working.*
2.	*Concepts of designing heat exchangers based on direction of flow.*
3.	*Concepts of designing heat exchangers based on constructional features.*
4.	*Basic knowledge on condensers and perform various calculations.*
5.	*Basic knowledge on vaporizers, evaporators, reboilers and perform various calculations.*
6.	*Design calculations of cooling towers.*

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	*Define different types of heat exchangers.*	
CO2	*Design the heat exchangers based on LMTD &Effectiveness.*	
CO3	*Design and analyze the shell and tube heat exchanger.*	
CO4	*Apply the fundamental, physical and mathematical aspects of condensation.*	
CO5	*Explain the fundamental, physical and mathematical aspects of boiling.*	
CO6	*Classify cooling towers and explain their technical features.*	

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

COURSE CONTENT	
UNIT I	Classification of heat exchangers: Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers, Gasketed plate heat exchanger, spiral plate heat exchanger, Lamella heat exchanger, extended surface heat exchanger, Plate fin, and Tubular fin.
UNIT II	Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multipass, cross flow heat exchanger design calculations. Double Pipe Heat Exchanger: Film Coefficient for fluids in annulus, fouling factors, calorific temperature, average fluid temperature, the calculation of double pipe exchanger, Double pipe exchangers in series-parallel arrangements.
UNIT III	Shell & Tube Heat Exchangers: Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.
UNIT IV	Condensation of single vapors: Calculation of a horizontal condenser, vertical condenser, De-super heater condenser, vertical condenser – sub-cooler, horizontal condenser – subcooler, vertical reflux type condenser, condensation of steam.

UNIT V	Vaporizers, Evaporators and Reboilers: Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler. Extended Surfaces: Longitudinal fins, weighted fin efficiency curve, calculation of a double pipe fin efficiency curve, calculation of a double pipe finned exchanger, calculation of a longitudinal fin shell and tube exchanger.
UNIT VI	Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb & dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill, Heat balance, heat transfer by simultaneous diffusion and convection. Analysis of cooling tower requirements, Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

TEXT BOOKS	
1.	Process Heat Transfer – D.Q. Kern, TMH.
2.	Cooling Towers by J.D. Gurney
REFERENCE BOOKS	
1.	Heat Exchanger Design – A.P.Fraas and M.N. Ozisick. John Wiely & sons, New York.
WEB RESOURCES	
1.	
2.	

IV Year – II Semester

NON - DESTRUCTIVE EVALUATION

(ELECTIVE -III)

Course Category	Professional Core	**Course Code**	16ME8D09
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	Basics of non-destructive testing and radiographic techniques.
2.	Concept of ultrasonic testing, equipment and variables affecting ultrasonic test.
3.	Concept of liquid penetrant test and eddy current testing.
4.	Fundamentals of magnetic particle testing techniques and equipment's.
5.	Fundamentals of infrared and thermal testing, techniques and equipment's.
6.	Applications of non-destructive testing and evaluation in various industries.

COURSE OUTCOMES		
By the end of the Course, the Student will be able to**:**		**BLOOMS TAXONOMY LEVEL**
CO1	Explain the basics of non-destructive testing and radiographic techniques.	Understanding
CO2	Define the different ultrasonic testing techniques	Understanding
CO3	Demonstrate about liquid penetration test and eddy current test.	Applying
CO4	Analyze the magnetic particle testing techniques and their fundamental concepts.	Analyzing
CO5	Demonstrate the concept of infrared and thermal testing.	Applying
CO6	Apply the NDE applications on various industries.	Applying

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	-	2	3	2	-	-	-	-	-	-	2	2
CO2	2	3	-	2	2	2	-	-	-	-	-	-	3	2
CO3	2	3	-	2	2	2	-	-	-	-	-	-	2	2
CO4	2	3	-	2	3	2	-	-	-	-	-	-	3	2
CO5	2	3	-	2	3	2	-	-	-	-	-	-	3	1
CO6	3	3	-	3	3	2	-	-	-	-	-	-	3	2

COURSE CONTENT	
UNIT I	INTRODUCTION TO NON-DESTRUCTIVE TESTING AND RADIOGRAPHY TEST: Introduction to NDT and its classification- Radiography test**,** Sources of X and Gamma Rays and their interaction with Matter, Radiography equipment, Radiography Techniques, Safety Aspects of Industrial Radiography.
UNIT II	ULTRASONIC TEST**:** Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.
UNIT III	LIQUID PENETRANT TEST: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing. EDDY CURRENT TEST: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing.
UNIT IV	MAGNETIC PARTICLE TEST**:** Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT V	INFRARED AND THERMAL TESTING: Introduction and fundamentals to infrared and thermal testing- Heat transfer and passive technique- Lock in and pulse thermography- Contact and non- contact thermal inspection methods- Heat sensitive paints- Heat sensitive papers-thermally quenched phosphors liquid crystals – techniques for applying liquid crystals – other temperature sensitive coatings – inspection methods – Infrared radiation and infrared detectors – thermos mechanical behavior of materials- IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures- Case studies.
UNIT VI	INDUSTRIAL APPLICATIONS OF NDE**:** Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

TEXT BOOKS	
1.	Non-destructive
2.	Ultrasonic testing by Krautkramer andKrautkramer.
3.	Non-destructive testing, Warren, JMcGonnagle / Godan and Breach Science Publishers.
REFERENCE BOOKS	
1.	Ultrasonic inspection training for NDT: E. A. Gingel, Prometheus Press.
2.	ASTM Standards, Vol 3.01, Metals andalloys.
3.	Non-destructive, Hand Book – R. Hamchand.
4.	Nondestructive Testing, Louis Cartz, ASM International
5.	Nondestructive Evalution and Quality Control, ASM Handbook, Vol. 17.
WEB RESOURCES	
1.	https://www.asnt.org/MinorSiteSections/AboutASNT/Intro-to-NDT
2.	nptel.ac.in/courses/113106070/

IV Year – II Semester

QUALITY AND RELIABILITY ENGINEERING

(ELECTIVE -III)

Course Category	Professional Core	**Course Code**	**16ME8D10**
Course Type	Theory	**L-T-P-C**	4-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSE OBJECTIVES	
1.	*The approaches and techniques to assess and improve process and/or product quality and reliability*
2.	*The principles and techniques of Statistical Quality Control and their practical uses in product and/or process design and monitoring.*
3.	*The process control and acceptance sampling procedure and their application.*

4.	*The tolerance design, QFD matrix ISO standards.*
5.	*Techniques of modern reliability engineering tools*
6.	*The modern practices in maintenance and reliability techniques.*

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**BLOOMS TAXONOMY LEVEL**
CO1	*Define Quality concepts and quality improvement*	
CO2	*Summarize the statistical process control and SQC table.*	
CO3	*Explain the concept of acceptance sampling by variables and attributes.*	
CO4	*Build the various characteristics in tolerance design and QFD matrix.*	
CO5	*Explain the concept of reliability and their improvements*	
CO6	*Analyze the modern practices in maintenance*	

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

COURSE CONTENT	
UNIT I	**INTRODUCTION:** Quality value and engineering – quality systems – quality engineering in product design and production process – system design – parameter design – tolerance design, quality costs – quality improvement.
UNIT II	**STATISTICAL QUALITY CONTROL:** Definition of SQC, benefits and limitation of SQC, Statistical process control X, R, P, C charts, other types of control charts, process capability, process capability analysis, process capability index, use of SQC tables.
UNIT III	**ACCEPTANCE SAMPLING:** Acceptance sampling based on reliability test – O.C Curves. Acceptance sampling by variables and attributes, design of sampling plans, single, double, sequential and continuous sampling plans, design of various sampling plans.
UNIT IV	**ONLINE METHJODS AND QFD**: Loss function, tolerance design – N type, L type, S type; determination of tolerance for these types. online quality control – variable characteristics, attribute characteristics, parameter design. Quality function deployment – house of quality, QFD matrix, total quality management concepts. quality information systems, quality circles, introduction to ISO 9000 standards. Need for ISO 9000- ISO 9000-2000 Quality System.

UNIT V	**RELIABIITY ANALYSIS**: Reliability – Evaluation of design by tests - Hazard Models, Linear, Releigh, Weibull. Failure Data Analysis, reliability prediction based on weibull distribution, Reliability improvement.
UNIT VI	**COMPLEX RELIABILITY SYSTEM**: Complex system, reliability, reliability of series, parallel & standby systems & complex systems & reliability prediction and system effectiveness. Maintainability, availability, economics of reliability engineering, replacement of items, maintenance costing and budgeting, reliability testing.

TEXT BOOKS	
1.	G Taguchi, 'Quality Engineering in Production Systems - Mc Graw Hill.
2.	E. Bala Guruswamy, 'Reliability Engineering', Tata McGraw Hill.
3.	Montgomery "Statistical Quality Control : A Modern Introduction" Wiley.
REFERENCE BOOKS	
1.	Frank.M.Gryna Jr. "Jurans Quality planning & Analysis", McGraw Hill.
2.	Philipposs, 'Taguchi Techniques for Quality Engineering', Mc Graw Hill.
3.	LS Srinath, 'Reliability Engineering', Affiliated East West Pvt. Ltd..
4.	Eugene Grant, Richard Leavenworth "Statistical Process Control", McGraw Hill.
WEB RESOURCES	
1.	https://onlinecourses.nptel.ac.in/noc18_mg02/preview
2.	https://onlinecourses.nptel.ac.in/noc17_mg18/preview
3.	https://onlinecourses.nptel.ac.in/noc17_mg08/preview
4.	https://onlinecourses.nptel.ac.in/noc18_mg04/preview