PONDICHERRYUNIVERSITY
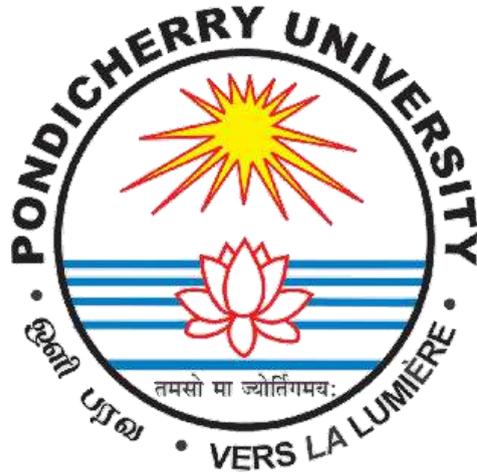

Bachelor of Technology

ROBOTICSANDAUTOMATION

REGULATIONS,CURRICULUM AND SYLLABUS

(2019-2020)

PONDICHERRY UNIVERSITY

BACHELOR OF TECHNOLOGY PROGRAMMES

(EIGHT SEMESTERS)

REGULATIONS

1. CONDITIONS FOR ADMISSION:

(a) Candidates for admission to the first semester of the 8 semester B.Tech. Degree programme should be required to have passed:

The Higher Secondary Examination of the (10+2) curriculum (Academic Stream) prescribed by the Government of Tamil Nadu or any other examination equivalent there to with minimum of 45% marks(a mere pass for OBC and SC/ST candidates) in aggregate of subjects – Mathematics, Physics and any one of the following optional subjects: Chemistry / Biotechnology/ Computer Science / Biology (Botany & Zoology)or an Examination of any University or Authority recognized by the Executive Councilof the Pondicherry University as equivalent thereto.

(b) For Lateral entry into third semester of the eight semesters B.Tech programme:

The minimum qualification for admission is a pass in three year diploma or four year sandwich diploma course in engineering / technology with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in the subjects covered from 3rd to final semester or a pass in any B.Sc. course with mathematics as one of the subjects of study with a minimum of 60 % marks (50% marks for OBC and amere pass for SC/ST candidates) in aggregate in main and ancillary subjects excluding language subjects. The list of diploma programs approved for admission for each of the degree programs is given in **Annexure A**.

2. AGE LIMIT:

The candidate should not have completed 21 years of age as on 1st July of the academic yearunderconsideration.For LateralEntryadmissiontosecondyear ofdegree programme, candidates should not have completed 24 years as on 1st July of theacademic year under consideration. In the case of SC/ST candidates, the age limit is relaxable by 3 years for both the cases.

3. DURATION OF PROGRAMME:

The Bachelor of Technology degree programme shall extend over a period of 8 consecutive semesters spread over 4 academic years – two semesters constituting one academic year. The duration of each semester shall normally be 15 weeks excluding examinations.

4. ELIGIBILITY FOR THE AWARD OF DEGREE:

No candidate shall be eligible for the award of the degree of Bachelor of Technology, unless he/she has undergone the course for a period of 8 semesters (4 academic years) /6 semesters (3 academic years for Lateral Entry candidates) in the faculty of Engineering and has passed the prescribed examinations in all the semesters.

5. BRANCHES OF STUDY:

Branch I   - Civil Engineering
Branch II   - Mechanical Engineering
Branch III - Electronics & Communication Engineering Branch
IV - Computer Science & Engineering
Branch V   - Electrical & Electronics Engineering
Branch VI   - Chemical Engineering
Branch VII - Electronics & Instrumentation Engineering Branch
VIII - Information Technology
Branch IX   - Instrumentation & Control Engineering
Branch X   - Biomedical Engineering
Branch XI   - Robotics and Automation

or any other branches of study as and when offered. The branch allocation shall be ordinarily done at the time of admission of the candidate to the first semester.

6. SUBJECTS OF STUDY:

The subjects of study shall include theory and practical courses as given in the curriculum and shall be in accordance with the prescribed syllabus. The subjects of study for the first two semesters shall be common for all branches of study.

7. EXAMINATIONS:

The theory and practical examinations shall comprise continuous assessment throughout the semester in all subjects as well as university examinations conducted by Pondicherry University at the end of the semester (November / December or April /May).

(a) Theory courses for which there is a written paper of 75 marks in the university examination.

The Internal Assessment marks of 25 has to be distributed as 10 marks each for two class tests and 5 marks for class attendance in the particular subject. The distribution of marks for attendance is as follows:

5 marksfor95% andabove
4marksfor 90%andabovebutbelow95%
3marksfor85%andabovebutbelow90%
2marksfor80%andabovebutbelow85%
1mark for 75% andabovebut below80%

A minimum of threetests are to be conducted for every theory subject and, of them twobest are to be considered for computation of internal assessment marks.

(b) Practical courses for which there is a university practical examination of 50marks: Every practical subject carries an internal assessment mark of 50 distributed as follows:
(i) Regularlaboratoryexercisesand record– 20 marks
(ii) Internalpractical test   -15 marks
(iii) Internalviva-voce   –5 marksand
(iv) Attendance   –10 marks.
The marks earmarked for attendance are to be awarded as follows:
10 marks for 95% and above
8marksfor 90%andabovebutbelow95%
6marksfor 85%andabovebutbelow90%
4marksfor 80% andabovebut below85%
2marksfor 75%andabovebutbelow80%

8. REQUIREMENTFORAPPEARINGFORUNIVERSITY EXAMINATION:

Acandidateshallbepermittedtoappearforuniversityexaminationsattheendofany semester only if:

(i) He / She secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration.

(Candidates who secure overall attendance greater than 60% and less than 75% have to paya condonation fee as prescribed by the Universityalong with a medical certificate obtained from a medical officer not below the rank of Assistant Director)

(ii) He / She earns a progress certificate from the Head of the institution for having satisfactorilycompletedthe course of studyin all the subjects pertainingto that semester.

(iii) His / Her conduct is found to be satisfactory as certified by the Head of the institution.

A candidate who has satisfied the requirement (i) to (iii) shall be deemed to have satisfied the course requirements for the semester.

9. PROCEDURE FOR COMPLETING THE COURSE:

A candidate can join the course of study of any semester only at the time of its normal commencement and only if he/she has satisfied the course requirements for the previous semester and further has registered for the university examinations of the previous semester in all the subjects as well as all arrear subjects if any.

However, the entire course should be completed within 14 consecutive semesters (12 consecutive semesters for students admitted under lateral entry).

10. PASSING MINIMUM:

(i) A candidate shall be declared to have passed the examination in a subject of study only if he/she secures not less than 50% of the total marks (Internal Assessment plus University examination marks) and not less than 40% of the marks in University examination.

(ii) A candidate who has been declared —Failed‖ in a particular subject may reappear for that subject during the subsequent semesters and secure a pass. However, there is a provision for revaluation of failed or passed subjects provided he/she fulfills the following norms for revaluation.

(a) Applications for revaluation should be filed within 4 weeks from the date of declaration of results or 15 days from the date of receipt of marks card whichever is earlier.

(b) The candidate should have attended all the college examinations as well as university examinations.

(c) If a candidate has failed in more than two papers in the current university examination, his/her representation for revaluation will not be considered.

(d) The request for revaluation must be made in the format prescribed duly recommended by the Head of the Institution along with the revaluation fee prescribed by the University.

The internal assessment marks obtained by the candidate shall be considered only in the first attempt for theory subjects alone. For the subsequent attempts, University examination marks will be made up to the total marks. Further the University examination marks obtained in the latest attempt shall alone remain valid in total suppression of the University examination marks obtained by the candidate in earlier attempts.

11. AWARD OF LETTER GRADES:

The assessment of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain

points,willbeawardedaspertherangeoftotalmarks(outof100)obtainedbythe candidate, as detailed below:

RangeofTotalMarks	LetterGrade	GradePoints
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	F	0
Incomplete	FA	

Note:_F_denotesfailureinthecourse._FA_denotesabsent/detainedasperclause8.

Afterresultsaredeclared,gradesheetswillbeissuedtothestudents.Thegrade sheets will contain the following details:

(a) Thecollegeinwhichthecandidate hasstudied.

(b) The listofcoursesenrolledduringthe semesterandthe gradesscored.

(c) The Grade Point Average (GPA) for the semester and The CumulativeGrade Point Average (CGPA) of all enrolled subjects from first semester onwards.

(d) GPA is the ratio of sum of the products of the number of credits (C) of courses registered and the corresponding grades points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses

GPA=(Sumof(C×GP)/SumofC)

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. FA grades are to be excluded for calculating GPA and CGPA.

(e) TheconversionofCGPAintopercentagemarksisasgivenbelow

%Mark=(CGPA-0.5)× 10

12. AWARDOFCLASSANDRANK:

(i)   Acandidatewhosatisfiesthecourserequirementsforallsemestersandwho passesalltheexaminationsprescribedforalltheeightsemesters(sixsemestersfor

lateralentrycandidates)withinamaximumperiodof7years(6yearsforlateral entrycandidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

(**i**)A candidate who qualifies for the award of the degree passing in all subjects pertainingto semesters3to 8in his/her first appearance within 6consecutivesemesters (3 academic years) and in additionsecures a CGPAof 8.50 and above for thesemesters 3to8 shallbedeclaredtohavepassedtheexaminationin**FIRSTCLASS**with DISTINCTION.

(**i**)A candidate who qualifies for the award of the degree by passing in all subjects relating to semesters 3 to 8 within a maximum period of eight semesters after his/her commencement of study in the third semester and in addition securesCGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS**.

(iv)   All other candidates who qualify for the award of degree shall be declared tohave passed the examination in **SECOND CLASS**.

(v)   For the Award of Universityranks and Gold Medal for each branch of study, the CGPA secured from 1st to 8th semester alone should be considered and it is mandatory that the candidate should have passed all the subjects from 1st to 8th semester in the first attempt. Rank certificates would be issued to the first ten candidates in each branch of study.

13. PROVISIONFORWITHDRAWAL:

A candidate may, for valid reasons, and on the recommendation of the Head of the Institution be granted permission bythe Universityto withdraw from writingthe entire semester examination as one Unit. The withdrawal application shall be valid only if itis made earlier than the commencement of the last theory examination pertainingto that semester. Withdrawal shall be permitted only once during the entire course. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded DISTINCTION whereas they are not eligible to be awarded a rank.

14. DISCONTINUATIONOFCOURSE:

Ifacandidatewishestotemporarilydiscontinuethecourseforvalidreasons,he/she   shall apply through the Head of the Institution in advance and obtain a written order from the University permitting discontinuance. A candidate after temporary discontinuance may rejoin the course only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees to the University. The total period of completion of the course reckoned from the commencement of the first semester to which the candidate wasadmitted shall not in anycase exceed 7 years, including of the period of discontinuance.

15.

16. REVISIONOFREGULATIONSANDCURRICULUM:

The University may from time to time revise, amend or change the regulations ofcurriculum and syllabus as and when found necessary.

ANNEXURE– A

(Diplomaprogramsforadmission forB.Tech. Lateral Entry)

B.Techcoursesinwhich admissionissought	Diplomacourseseligibleforadmission
CivilEngineering	CivilEngineering CivilandRuralEngineering ArchitecturalAssistantship Architecture AgriculturalEngineering
MechanicalEngineering	Mechanical Engineering Automobile Engineering AgriculturalEngineering MechanicalandRuralEngineering RefrigerationandAir-conditioning AgriculturalEngineering&FarmEquipment Technology MetallurgyProductionEngineering Machine Design & Drafting MachinetoolmaintenanceandRepairs Printing Technology / Engineering Textile Engineering / Technology Tool Engineering
ElectricalandElectronicsEngineering Electronics & Communication Engineering ElectronicandInstrumentation Engineering InstrumentationandControlEngineering Bio Medical Engineering	ElectricalEngineering Electrical and Electronics Engineering ElectronicsandInstrumentationEngineering Instrumentation Engineering / Technology Electronics and Communication Engg. ElectronicsEngineering MedicalElectronics InstrumentationandControlEngineering Applied Electronics
RoboticsandAutomationEngineering	Electrical and Electronics Engineering ElectronicsandCommunicationEngineering. Electronics and Instrumentation Engineering Computer Science and Engineering Information Technology InstrumentationandControlEngineering Mechanical Engineering Automobile Engineering RefrigerationandAir-conditioning ProductionEngineering

ChemicalEngineering	ChemicalEngineering ChemicalTechnology PetrochemicalTechnology PetroleumEngineering Ceramic Technology Plastic Engineering Paper&Pulp Technology PolymerTechnology
InformationTechnology Computer Science &Engineering	Computer Science andEngineering ComputerTechnology Electrical and Electronics Engineering Electronics&CommunicationEngineering Electronics&InstrumentationEngineering InstrumentationEngineering/ Technology

Curriculum

for

B.Tech.
Robotics and Automation

2019-2020

PROGRAMMEEDUCATIONALOBJECTIVES(PEOs)

- PEO1:**Employability:**Our Graduates shall be suitably employed with professional competency and knowledge of modern tools.

- PEO2:**Higher Education:** Our Graduates shall be capable to pursue higher studies/research in the field of engineering and management.

- PEO3:**Entrepreneurship:** Our Graduates shall be prepared for a successful career by meetingever increasingdemandsrequiredbyRoboticsand Automation profession and enable them to become an entrepreneur.

- PEO4:**Professional and Ethical values:**Our Graduates cultivate professional and ethical attitudes with effective communication skills, team work and multidisciplinary approach related to engineering issues.

PROGRAMOUTCOMES(POs)

Graduating students of Robotics and Automation Engineering from Pondicherry University will have the ability to:

- **PO1:Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

- **PO2:Problem analysis:** Identify, formulate, review research literature, and analyze complexengineeringproblemsreachingsubstantiatedconclusionsusingfirstprinciples of mathematics, natural sciences, and engineering sciences.

- **PO3:Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural,societal and environmental considerations.

- **PO4:Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

- **PO5:Modern tool usage:**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- **PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

- **PO7:Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- **PO8: Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- **PO9:Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- **PO10:Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO11:Projectmanagementandfinance:**Demonstrateknowledgeandunderstanding of the engineeringand management principles and applythese to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- **PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PONDICHERRYUNIVERSITY

B.Tech(RoboticsandAutomation)

CURRICULUM

ISEMESTER

CodeNo.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
T101	Mathematics –I	3	1	-	4	25	75	100
T102	Physics	4	-	-	4	25	75	100
T103	Chemistry	4	-	-	4	25	75	100
T110	BasicCivilandMechanical Engineering	4	-	-	4	25	75	100
T111	EngineeringMechanics	3	1	-	4	25	75	100
T112	CommunicativeEnglish	4	-	-	4	25	75	100
	Practical							
P104	PhysicsLaboratory	-	-	3	2	50	50	100
P105	Chemistry Laboratory	-	-	3	2	50	50	100
P106	WorkshopPractice	-	-	3	2	50	50	100
	Total	22	2	9	30	300	600	900

II SEMESTER

CodeNo.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
T107	Mathematics –II	3	1	-	4	25	75	100
T108	Material Science	4	-	-	4	25	75	100
T109	EnvironmentalScience	4	-	-	4	25	75	100
T104	Basic Electrical and ElectronicsEngineering	3	1	-	4	25	75	100
T105	EngineeringThermodynamics	3	1	-	4	25	75	100
T106	ComputerProgramming	3	1	-	4	25	75	100
	Practical							
P101	ComputerProgramming Laboratory	-	-	3	2	50	50	100
P102	Engineering Graphics	2	-	3	2	50	50	100
P103	BasicElectricalandElectronics Laboratory	-	-	3	2	50	50	100
P107	NSS/NCC*	-	-	-	-	-	-	-
	Total	22	4	9	30	300	600	900

III SEMESTER

CodeNo.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
RAT31	LinearAlgebra	3	1	-	4	25	75	100
RAT32	ElectronicDevicesandCircuits	4	-	-	4	25	75	100
RAT33	Programmingin Python	4	-	-	4	25	75	100
RAT34	SensorsandInstrumentation	4	-	-	4	25	75	100
RAT35	ElectricalMachinesandDrives	3	1	-	4	25	75	100
RAT36	StrengthofMaterials	3	1	-	4	25	75	100
	Practical							
RAP31	ElectronicDevicesandCircuits Laboratory	-	-	3	2	50	50	100
RAP32	Programmingin Python Laboratory	-	-	3	2	50	50	100
RAP33	ElectricalMachinesandDrives Laboratory	-	-	3	2	50	50	100
	Total	21	3	9	30	300	600	900

IV SEMESTER

CodeNo.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
RAT41	FourierSeriesandPartial Differential Equations	3	1	-	4	25	75	100
RAT42	PrinciplesofRobotics	4	-	-	4	25	75	100
RAT43	AnalogandDigital Electronics	4	-	-	4	25	75	100
RAT44	AutomaticControlSystems	3	1	-	4	25	75	100
RAT45	KinematicsandDynamicsof Machines	4	-	-	4	25	75	100
RAT46	Hydraulicsand Pneumatics	4	-	-	4	25	75	100
	Practical							
RAP41	AnalogandDigitalElectronics Laboratory	-	-	3	2	50	50	100
RAP42	KinematicsandDynamics Laboratory	-	-	3	2	50	50	100
RAP43	HydraulicsandPneumatics Laboratory	-	-	3	2	50	50	100
SPP44	PhysicalEducation*	-	-	-	-	-	-	-
	Total	22	2	9	30	300	600	900

*Studentisrequiredtosecurea passandnogradewillbeawarded

V SEMESTER

CodeNo.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UEE	TM
Theory								
RAT51	Statisticsand Numerical Methods	3	1	-	4	25	75	100
RAT52	Microcontrollerand EmbeddedSystemDesign	4	-	-	4	25	75	100
RAT53	ProgrammableLogic Controllers	4	-	-	4	25	75	100
RAT54	RoboticControlSystems	3	1	-	4	25	75	100
RAT55	CNCMachineand Metrology	4	-	-	4	25	75	100
	ElectiveI	4	-	-	4	25	75	100
Practical								
RAP51	Microcontrollerand EmbeddedSystem DesignLaboratory	-	-	3	2	50	50	100
RAP52	PLCandRoboticsLaboratory	-	-	3	2	50	50	100
RAP53	CNCandMetrology Laboratory	-	-	3	2	50	50	100
HSP54	GeneralProficiency–I	-	-	3	1	100	-	100
	Total	22	2	12	31	400	600	1000

VI SEMESTER

Code No.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
Theory								
RAT61	Modelingand Simulation	3	1	-	4	25	75	100
RAT62	RobotKinematicsand Dynamics	3	1	-	4	25	75	100
RAT63	Programmingfor Robotics	3	1	-	4	25	75	100
RAT64	AutomationSystemDesign	4	-	-	4	25	75	100
RAT65	DesignofMechanical TransmissionSystems	4	-	-	4	25	75	100
	ElectiveII	4	-	-	4	25	75	100
Practical								
RAP61	ModelingandSimulation Laboratory	-	-	3	2	50	50	100
RAP62	AutomationSystemDesign Laboratory	-	-	3	2	50	50	100
RAP63	Virtual Instrumentation Laboratory	-	-	3	2	50	50	100
HSP64	GeneralProficiency–II	-	-	3	1	100	-	100
	Total	21	3	12	31	375	525	900

VII SEMESTER

CodeNo.	Name of theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
RAT71	IndustrialRoboticsand Material Handling	4	-	-	4	25	75	100
RAT72	ArtificialIntelligencefor Robotics	4	-	-	4	25	75	100
RAT73	TotallyIntegratedAutomation	4	-	-	4	25	75	100
	ElectiveIII	4	-	-	4	25	75	100
	ElectiveIV	4	-	-	4	25	75	100
	Practical							
RAP71	TotallyIntegratedAutomation Laboratory	-	-	3	2	50	50	100
RAP72	InnovativePractices	-	-	3	2	100	-	100
RAP73	IndustrialVisit/Training	-	-	2	1	100	-	100
RAPW7	ProjectWork-I	-	-	6	4	100	-	100
	Total	20	-	14	29	475	425	900

VIII SEMESTER

CodeNo.	Name of theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
RAT81	ProfessionalEthics	2	-	-	1	100	-	100
RAT82	MaintenanceandSafety Engineering	4	-	-	4	25	75	100
	ElectiveV	4	-	-	4	25	75	100
	ElectiveVI	4	-	-	4	25	75	100
	Practical							
RAPW8	ProjectWork-II	-	-	9	8	50	50	100
	Total	14	-	9	21	225	375	600

Totalcredits–232

PROFESSIONAL ELECTIVES FOR ROBOTICS AND AUTOMATION

LIST OF ELECTIVES

SEMESTER V - ELECTIVE I

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
RAE01	VLSI Design	4	-	-	4	25	75	100
RAE02	Soft Computing	4	-	-	4	25	75	100
RAE03	Industrial Networking	4	-	-	4	25	75	100
RAE04	Field and Service Robotics	4	-	-	4	25	75	100
RAE05	PC based Industrial Automation	4	-	-	4	25	75	100

SEMESTER VI - ELECTIVE II

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
RAE06	Image Processing and Vision Systems	4	-	-	4	25	75	100
RAE07	FPGA Based System Design	4	-	-	4	25	75	100
RAE08	Industrial Drives for Automation	4	-	-	4	25	75	100
RAE09	Applied Robotics	4	-	-	4	25	75	100
RAE10	Wireless Sensor Networks for Robotics	4	-	-	4	25	75	100

SEMESTER VII - ELECTIVE III

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
RAE11	Internet Tools & Java Programming	4	-	-	4	25	75	100
RAE12	Mobile Robotics	4	-	-	4	25	75	100
RAE13	Vision Guided Robotics	4	-	-	4	25	75	100
RAE14	Medical Robotics	4	-	-	4	25	75	100
RAE15	Industrial IoT & Automation	4	-	-	4	25	75	100

SEMESTER VII-ELECTIVE IV

CodeNo.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
RAE16	OperationsResearch	4	-	-	4	25	75	100
RAE17	ComputerIntegrated Manufacturing	4	-	-	4	25	75	100
RAE18	ReliabilityandQualitycontrol	4	-	-	4	25	75	100
RAE19	ProcessPlanningand Cost Estimation	4	-	-	4	25	75	100
RAE20	Microand Nano ElectromechanicalSystems	4	-	-	4	25	75	100

SEMESTER VIII-ELECTIVE V

CodeNo.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
RAE21	CognitiveRobotics	4	-	-	4	25	75	100
RAE22	MachineLearningfor Robotics	4	-	-	4	25	75	100
RAE23	Microbotics	4	-	-	4	25	75	100
RAE24	COBOT(CollaborativeRobotics)	4	-	-	4	25	75	100
RAE25	ProductDesignand Development	4	-	-	4	25	75	100

SEMESTER VIII-ELECTIVE VI

CodeNo.	Nameof theSubjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
RAE26	LeanManufacturing	4	-	-	4	25	75	100
RAE27	EntrepreneurshipDevelopment	4	-	-	4	25	75	100
RAE28	DisasterManagement	4	-	-	4	25	75	100
RAE29	TotalQualityManagement	4	-	-	4	25	75	100
RAE30	SupplyChainManagement	4	-	-	4	25	75	100

T101MATHEMATICS-I   3   1   0   4

COURSEOBJECTIVES

- To introduce and familiarize withfunctions of several variables and the idea of applying calculus concepts to problems in Engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- Tointroduceeffectivemathematicaltoolsforthesolutionsofdifferential equations that model physical processes.

COURSEOUTCOMES

Onsuccessfulcompletionofthemodulestudentswillbeable to:

- Applyknowledgeofmathematicstosolve functionsofseveralvariables.
- Identify, formulate, and solve engineering problems like multiple integrals and their usage.
- Tosolvedifferentialequationsthatmodelphysicalprocessesusingeffective mathematical tools

UNITI:CALCULUS

Curvature,radiusofcurvature,evolutesandinvolutes.BetaandGammafunctionsand their properties.

                                                                (12)

UNITII:FUNCTIONSOFSEVERALVARIABLES

Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of variables, Jacobians and their properties, Taylor_s series for functions of two variables, Maxima and minima, Lagrange_s method of undetermined multipliers.   (12)

UNITIII:MULTIPLEINTEGRALS ANDAPPLICATIONS

Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).   (12)

UNITIV:DIFFERENTIAL EQUATIONS

Exact equations, First order linear equations, Bernoulli_s equation, orthogonal trajectories, growth, decay and geometrical applications. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut_s type.(12)

UNITV:DIFFERENTIALEQUATIONS(HIGHERORDER)

Linear differential equations of higher order – with constant coefficients, the operator D, Euler_s linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method simple applications to electric circuits.   (12)

TEXT BOOKS:

1. Venkataraman,M.K,EngineeringMathematics(FirstYear),SecondEdition,TheNational Publishing Company, Chennai 2010 (For units I, III, IV, V)
2. GrewalB.S.,HigherEngineeringMathematics,KhannaPublishers,NewDelhi,41st Edition,2011.(ForUnitIIonly)

REFERENCEBOOKS:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. KandasamyP.etal,EngineeringMathematics,Vol.1&2,S.Chand&Co.,New Delhi.
3. RamanaB.V.,HigherEngineeringMathematics,TataMcGrawHillNewDelhi,11th Reprint,2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi, 8th Edition.
5. Bali,N.P,andManishGoyal,AdvancedEngineeringMathematics,Lakshmi Publications, New Delhi, 2007.

T102 PHYSICS   4   0   0   4

COURSEOBJECTIVES
- To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transformes modern-day society.
- To exposethestudentsto different areasof physicswhich have directrelevanceand applications to different Engineering disciplines
- To understand the conceptsand applicationsof Ultrasonics, opticsand some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics.

COURSEOUTCOMES
Onsuccessfulcompletionofthemodule studentswillbeableto:
- Apply knowledge of science and engineering to understand physics and its significant contributions in the advancement of technology and invention of new products that dramatically transform modern-day society.
- Identify different areas of physics which have direct relevance and applications to different Engineering disciplines.
- Applyfundamental knowledge to understand applications ofUltrasonics, opticsand some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics.

UNITI: ACOUSTICS&NDT
Ultrasonics- Ultrasonic Waves Productions (Piezoelectric & Magnetostriction method) – Detections (Acoustic Grating). NDT application – Ultrasonic Echo method – Liquid Penetrant method Acoustics - Factors affecting Acoustic of Buildings (Reverberation, Loudness, Focusing, Echo, Echelon Effect and Resonance) and their Remedies - Sabine_s formula for Reverberation Time–Doppler effect and its application to Radars (elementary idea)   (9)

UNITII:OPTICS
Interference-Air Wedge – Michelson_s Interferometer – Wavelength Determination – Interference Filter – Antireflection Coatings.Diffraction - Diffraction Grating – Dispersive power of grating - Resolving Power of Grating & Prism. Polarization –Basic concepts of Double Refraction - Huygens Theory of Double Refraction – Quarter and Half WavePlates – Specific Rotary Power – Laurent Half Shade Polari meter.   (9)

UNITIII:LASERS&FIBEROPTICS
Lasers - Principles of Laser – Spontaneous and Stimulated Emissions - Einstein_s Coefficients – Population Inversion and Laser Action – Types of optical resonators(qualitative Ideas) – Types of Lasers -NdYAG, CO_2 laser, GaAs Laser – Application of Lasers. Fiber Optics - Principle and Propagation of light in optical fiber – Numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode)- Application to sensors and Fiber Optic communication.   (9)

UNITIV:WAVE MECHANICS
Matter Waves – de Broglie Wavelength – Uncertainty Principle – Schrödinger Wave Equation – Time Dependent – Time Independent – Application to Particle in a One Dimensional potential Box – Quantum Mechanical Tunneling – Tunnel Diode.   (9)

UNITV:NUCLEARENERGYSOURCE
General Properties of Nucleus (Size, Mass, Density, Charge) – Mass Defect – Binding Energy - Disintegration in fission – Nuclear Reactor: Materials Used in Nuclear Reactors.– PWR – BWR – FBTR. Nuclear fusion reactions for fusion reactor – D-D and D-T reactions, Basic principles of nuclear fusion reactors.   (9)

TEXT BOOKS:

1. V Rajendran, Engineering Physics, 2ndEd., TMH, New Delhi 2011 (For Units Ito IV only)
2. Arthur Beiser, Concept of Modern Physics, 6thEd, TMH, New Delhi 2008 (For UnitV Only)

REFERENCEBOOKS:

1. AjayGhatak,Optics,TMH,NewDelhi,2007.
2. ThiagarajanandGhatak, LasersfundamentalandApplication,TMH,NewDelhi2008.
3. R.Murugesan,ModernPhysics,S.Chand&Co,NewDelhi2006
4. K.R.Nambiar,Lasers,NewAge International,NewDelhi,2008
5. ScienceofEngineeringMaterials,2ndEdition,C.M.SrivastavaandC.Srinivasan,New Age Int. (P) Ltd, New Delhi, 1997
6. AvadhanuluMNEngineeringPhysics, Vol-I,S.Chand&Co,2009.

COURSEOBJECTIVES
- ➢ Toknowabouttheimportance ofChemistryinEngineering domain
- ➢ Tounderstandthe chemistrybackgroundofindustrialprocess
- ➢ Toapplychemistryknowledgeforengineeringdisciplines

COURSEOUTCOMES
    Onsuccessfulcompletionofthemodulestudentswillbeable to:
- ➢ Applyknowledgeofscienceandengineeringtounderstandtheimportanceof Chemistry in Engineering domain
- ➢ IdentifydifferentElectrochemicalcellsandtheirusage forindustrialprocess
- ➢ Apply fundamentalknowledgeof chemistry andbuild aninterfaceoftheoretical concepts with industrial applications / engineering applications.

UNITI: WATER
Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water- EDTA method. Disadvantages of hardwater-boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softeningmethod– internal & external conditioning – Lime-soda process, Zeolite process and Ion exchange process. Desalination – reverse osmosis & electrodialysis. (9)

UNITII:POLYMERS
Classification, types of polymerization reactions – mechanism of radical, ionic andZiegler-Natta polymerizations. Polymer properties – chemical resistance, crystallinity and effect of temperature, Mn and Mw. Thermoplastics and thermosets. Preparation, properties and uses of PVC, TEFLON, Nylons, Bakelite, Polyurithane, Rubbers – vulcanization, synthetic rubber, BuNa-S, BuNa-N, silicone and butyl rubber. Conducting polymers – classification and applications. Polymer composites – FRP – laminar composites.Moulding constituents of plastic, moulding techniques – compression, injection, transfer and extrusion moulding. (9)

UNITIII:ELECTROCHEMICALCELLS
Galvanic cells, single electrode potential, standardelectrode potential, electromotiveseries. EMFof a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes-hydrogen calomel, Ag /AgCl & glass electrodes. Batteries - primary and secondarycells, laclanche cell, leadacid storage cell, Ni-Cd battery& alkaline battery. Fuel cells - H_2-O_2 fuel cell. (9)

UNITIV:CORROSIONANDITS CONTROL
Chemical & electrochemical corrosion-Galvanic series- galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion- corrosion control methods - cathodic protection and corrosion inhibitors. Protective coating - types of protective coatings-metallic coating-tinning and galvanizing, cladding, electroplating and Anodizing. (9)

UNITV:PHASE RULE
Definition and derivation of phase rule. Application to one component system - water and sulphur systems. Thermal analysis, condensed phase rule. Two component alloy systems - Pb-Ag, Cu-Ni and Mg-Zn systems. (9)

TEXT BOOKS:
1. P.C. Jain and Monika Jain, EngineeringChemistry, Dhanpat Rai and Sons, New Delhi 2010.

REFERENCEBOOKS:
1. S.S.Dara,ATextbookofEngineeringChemistry,11[th]Ed,S.Chand&Co.,Ltd.

NewDelhi.,2008.
2. B. K. Sharma, EngineeringChemistry, 3rdedition Krishna Prakashan Media (P) Ltd., Meerut, 2001
3. P.KannanandA.RaviKrishnan―EngineeringChemistry‖Hi-TechSriKrishna Publications, Chennai, 9thEd, 2009
4. N.Krishnamurthy,P.VallinayagamandD.Madhavan,EngineeringChemistry,2nd edition.PHILearningPVT., LTD,NewDelhi,2008.

T110BASICCIVILANDMECHANICALENGINEERING   **4   0   0   4**

COURSEOBJECTIVES
- Tobeabletodifferentiatethetypesofbuildingsaccordingto
national building code and understand building components and their functions as
well as different types of roads, bridges and dams.
- To explain the concepts of thermal systems used in power plants and narrate the
methods of harnessing renewable energies
- To explain the role of basic manufacturing processes and develop an intuitive
understanding of underlying working principles of mechanical machines and
systems.

COURSEOUTCOMES
Onsuccessfulcompletionofthemodule studentswillbeableto:
- Get an idea about construction procedure andsteps involved in component design of
the building.
- Understandthemanufacturingprocessessuchascasting,forming,joining,and
machining
- ApplytheFunctionsofPrimemovers,workingofICenginesandrefrigerator Understand.

PART-ACIVILENGINEERING

UNITI : BUILDINGS, BUILDING MATERIALS
Buildings-Definition-Classification according to NBC- plinth area, Floor area, carpet area,
floor space index-construction materials-stone, brick, cement, cement-mortar, concrete,
steel- their properties and uses.

(10)

UNITII:BUILDINGSANDTHEIRCOMPONENTS
Buildings- Various Components and their functions. Soils and their classification
Foundations-Functions and types of foundations, Masonry - Function and types, Floors-
Definition and types of floors, Roofs : Definition and types**.**   **(10)**

UNITIII:BASIC INFRASTRUCTURE
Basic Infrastructure: Surveying-classification, general principles, types, uses, instruments
used. Roads – types : Components, types and their advantage and disadvantage. Bridges-
componentsandtypes of bridges. Dams-Purpose, types of dams. Watersupply-sources and
quality requirements need and principles of Rainwater harvesting.   (10)

PART - B MECHANICAL ENGINEERING

UNITIV:INTERNALANDEXTERNALCOMBUSTIONSYSTEMS
IC engines – Classification – working principles – Diesel and petrol engines: two stroke
and four stroke engines. Merits and demerits.
Steam generators (Boilers) – Classification – Constructional features (of onlylow pressure
boilers)– Boiler mountings and accessories. Merits and demerits- Applications.   **(10)**

UNITV:POWERGENERATIONSYSTEMS
Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear power plants –
Schemes and layouts (Description Only) – Solar – Wind - Geothermal – Wave – Tidal and
Oceans thermal Energy Conversion systems – Basic power plant schemes and layouts
(Description only).   **(10)**

UNITVI:MANUFACTURINGPROCESS

Machines– Lathe –Drilling–Bending– GrindingShearing(Descriptiononly)Machining Processes – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filing – Sawing – Grinding. Moulding and Metal Joining - Pattern making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only). **(10)**

TEXT BOOKS:

1. Natarajan,KV,BasicCivilEngineering,11thEdition,DhanalakshmiPublications Chennai, 2011. (For Units I to III)
2. Venugopal ,K and PrabhuRaja, BasicMechanical Engineering, Anuradha Publisher, 2012 (For Units IV to VI).
3.

REFERENCEBOOKS:

1. PurushothamaRaj.P.,Basiccivilengineering,3rdEdn.,DhanamPublications, Chennai,2001
2. Rajput,RK,EngineeringMaterials,SChand&Co.Ltd.,NewDelhi,2012.
3. Punmia,B.C.,et.al.,Surveying,Vol-I,LaxmiPublishers,NewDelhi, 2012.
4. Punmia,B.C.,et.alBuildingConstruction,LaxmiPublishers,NewDelhi,2012.
5. El.Wakil,M.M.,PowerPlantTechnology,McGrawHillBook Co.,1985.
6. HajraChoudhry,et.al.,WorkshopTechnologyVol IandII, MediaPromoters Publishers Pvt. Ltd., Bombay, 2004.
7. Lindberg,R.A. ProcessandMaterialsofManufacture,PHI,1999.
8. H.N.Gupta,R.C.GuptaandArunMittal,ManufacturingProcesses,NewAge Publications, 2001
9. Nagpal,PowerPlantEngineering,KhannaPublishers,Delhi,1998.

T111ENGINEERINGMECHANICS   3   1   0   4

COURSEOBJECTIVES
> To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions
> To comprehend the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation
> Toemphasistheconceptsthroughsolvedexamples

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
> Apply knowledge of mathematics, science and engineering to analyze the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions
> Design and conduct experiment, as well as to analyze the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and analyze dynamic equilibrium equation
> Design,constructandanalyzeEngineeringMechanicsthroughsolvedexamples

UNITI:FUNDAMENTALOF MECHANICS
Fundamental of Mechanics: Basic Concepts Force System and Equilibrium, Definition of Force, Moment and Couple, Principle of Transmissibility, Varignon_s theorem, Resultant of force system – Concurrent and non-concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stabilityof equilibrium, applications in solving the problems on static equilibrium of bodies.   **(12)**

UNITII:PRACTICALAPPLICATIONOFFORCE SYSTEM
Structural member:definition, Degree of freedom, concept of free bodydiagrams, types of supports and reactions, types of loads, Analysis of Trusses-method of joints, method of sections. Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.   **(12)**

UNITIII:PROPERTIESOFSURFACES
Properties ofsections – area,centroids oflines, areasand volumes, momentofinertia first moment of inertia, second moment of inertia and product moment of inertia, polarmomentofinertia,radiusofgyration,massmomentofinertia.   **(12)**

UNITIV:KINEMATICSAND KINETICSOFPARTICLES
Equations of motion - Rectilinear motion, curvelinear motion, Relative motion, D_Alembert_s principle, work- Energy equation – Conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact.   **(12)**

UNITV: KINEMATICSANDKINETICSOFRIGIDBODIES
Plane motion, Absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum.   **(12)**

TEXT BOOKS:
1. Rajesekaran,SandSankaraSubramanian.,G.,EngineeringMechanics,VikasPublishing House Private Ltd., 2012.

REFERENCEBOOKS:
1. Palanichamy,M.S.Nagan,S.,EngineeringMechanics–Statics&Dynamics,Tata McGraw-Hill,2001.
2. Beer,F.PandJohnsonJr.E.R,VectorMechanicsforEngineers,Vol.1Staticsand Vol.2 Dynamics, McGraw – Hill International Edition, 1997
3. Bhavikatti,S.SandK.G.Rajashekarappa, Engineering Mechanics, NewAge International (P) Ltd, New Delhi,2010.

T112 COMMUNICATIVE ENGLISH   4 0 0 4

COURSE OBJECTIVES
- To improve the LSRW skills of I year B.Tech students
- To instill confidence and enable the students to communicate with ease
- To equip the students with the necessary skills and develop their language prowess

COURSE OUTCOMES

On successful completion of the module students will be able to:
- Apply fundamental knowledge to improve the LSRW skills of I year B.Tech students
- To enable the students to communicate with ease
- Apply basic knowledge to equip the students with the necessary skills and develop their language prowess

UNIT I: BASIC COMMUNICATION THEORY

Importance of Communication – stages of communication, modes of communication – barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective listening skills.   **(12)**

UNIT II: COMPREHENSION AND ANALYSIS

Comprehension of technical and non-technical material- Skimming, scanning, inferring- Note making and extension of vocabulary, predicting and responding to context- Intensive Reading and Reviewing.   **(12)**

UNIT III: WRITING

Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, Definitions, Practice in Summary Writing – Four modes of writing – Use of dictionaries, indices, library references – making bibliographical entries with regard to sources from books, journals, internet etc.   **(12)**

UNIT IV: BUSINESS WRITING/CORRESPONDENCE

Report writing – Memoranda – Notice – Instruction – Letters – Resumes – Job applications.   **(12)**

UNIT V: ORAL COMMUNICATION

Basics of phonetics – Presentation skills – Group Discussions – Dialogue writing – Short Extempore–Debates-Role Plays-Conversation Practice.   **(12)**

TEXT BOOKS:
1. Robert J.Dixson., Complete Course in English, Prentice-Hall of India Pvt. New Delhi, 2006

REFERENCE BOOKS
1. Ashraf M.Rizvi., Effective Technical Communication. Tata-McGraw, 2005.
2. Boove, Courtland R et al., Business Communication Today. Delhi. Pearson Education, 2002.
3. Meenakshi Raman and Sangeeta Sharma., Technical Communication Principles And Practice, OUP, 2007.
4. Robert J.Dixson., Everyday Dialogues in English, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
5. Sethi, J and Kamalesh Sadanand., A Practical Course in English Pronunciation, Prentice-Hall of India Pvt. Ltd, New Delhi, 2007.

P104 PHYSICS LABORATORY   **0   0   3   2**

COURSE OBJECTIVES
  ➢ To provide a practical understanding of some of the concepts learnt in the theory course on Physics.

COURSE OUTCOMES
  ➢ An ability to understand, explain and use instrumental techniques for intensity pattern analysis
  ➢ Ability to operate optical equipments like Spectrometer, Polarimeter to find the optical properties like dispersive power, Resolving power and specific rotatory power
  ➢ Capable of handling screw gauge, vernier caliper and travelling microscope to calculate the required parameters
  ➢ Acquire basic knowledge about thermal conduction and magnetic field due to a current carrying coil

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Thermal conductivity – Lee_s DISC
2. Thermal conductivity - Radial flow
3. Spectrometer – Prism or Hollow prism
4. Spectrometer – Transmission grating
5. Spectrometer - Ordinary & Extraordinary rays
6. Newton_s rings
7. Air – wedge
8. Half shade polarimeter – Determination of specific rotatory power
9. Jolly_s experiment – determination of α
10. Magnetism: i–h curve
11. Field along the axis of coil carrying current
12. Vibration magnetometer – calculation of magnetic moment & pole strength
13. Laser experiment: wavelength determination using transmission grating, reflection grating (vernier calipers) & particle size determination
14. Determination of optical absorption coefficient of materials using laser
15. Determination of numerical aperture of an optical fiber
16. Electrical conductivity of semiconductor – two probe/four probe method
17. Hall effect in semiconductor

P105CHEMISTRYLABORATORY   **0   0   3   2**

COURSEOBJECTIVES
> Togainapracticalknowledgeof EngineeringChemistryinrelevanceto Industrialapplications

COURSEOUTCOMES
> Thestudentswillbeoutfittedwithhands-onknowledgeinthequantitative chemical analysis of water quality related parameters.

LISTOFEXPERIMENTS(ANY10 EXPERIMENTS)

1. Determinationofdissolvedoxygeninwater.
2. DeterminationoftotalhardnessofwaterbyEDTAmethod.
3. Determinationofcarbonateandbicarbonateinwater.
4. Estimationofchloridecontentin water.
5. EstimationofmagnesiumbyEDTA.
6. EstimationofAceticacidin vinegar.
7. Estimationofferrousbypermanganometry.
8. Estimationofferrousandferric ironinasolutionmixture bydichrometry.
9. Estimationofavailablechlorineinbleachingpowder.
10. Estimationofcopperincoppersulphatesolution.
11. Estimationofcalciumbypermanganometry.
12. Estimationofironbycolorimetry

DEMONSTRATIONEXPERIMENTS(ANYTWOOFTHE FOLLOWING)

1. DeterminationofCODofwater sample.
2. Determinationofleadbyconductometry.
3. Percentagecompositionofsugarsolutionbyviscometry

P106WORKSHOP PRACTICE   0   0   3   2

COURSEOBJECTIVES
- To conveythe basicsof mechanicaltoolsusedin engineering
- To establishhandsonexperienceonthe workingtools
- To developbasic jointsandfittingsusingthe handtools
- To establishtheimportance ofjointsandfittinginengineeringapplications
- To explaintheroleofbasicworkshopinengineering
- To develop an intuitive understanding of underlying physical mechanism used in mechanical machines.

COURSEOUTCOMES
- To acquireskillsinbasicengineeringpractice.
- To identifythehand toolsandinstruments.
- To acquire measuringskills.
- To acquirepracticalskillsinthetrades.
- To providesthe knowledgeofjobmaterialsinvariousshops.

I FITTING

StudyoftoolsandMachineries.Exercisesonsymmetric jointsandjointswithacuteangle
1. StudyoftoolsandMachineries
2. Symmetricfitting
3. Acuteanglefitting

II WELDING

Studyofarc andgasweldingequipmentandtools–Edge preparation –Exercisesonlap joint and V Butt joints –Demonstration of gas welding
1. Studyof arc and gasweldingequipment andtools
2. Simplelapwelding(Arc)
3. SingleVbuttwelding(Arc)

IIISHEETMETAL WORK

StudyoftoolsandMachineries –exercisesonsimpleproductslikeOfficetrayand waste collection tray
1. Studyoftoolsandmachineries
2. Funnel
3. Wastecollectiontray

IVCARPENTRY

StudyoftoolsandMachineries–ExercisesonLapjointsandMortise joints
1. Studyoftoolsandmachineries
2. Halflap joint
3. Corner mortise joint

T107MATHEMATICS–II

COURSEOBJECTIVES

- ➤ To develop the use of matrix algebra techniques for practical applications and to introduce the concepts of Curl, Divergence and integration of vectors in vector calculus which is needed for many application problems.
- ➤ To introduce Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations
- ➤ To acquaint the students with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.

COURSEOUTCOMES

Onsuccessfulcompletionofthemodulestudentswillbeable to:

- ➤ Apply knowledge of mathematics to solve matrix algebra techniques for practical applications and Curl, Divergence and integration of vectorsin vector calculus for many application problems.
- ➤ Identify, formulate, and solve engineering problems like Laplace transform whichis a useful technique in solvingmanyapplication problems and to solve differential and integral equations
- ➤ Applyformulae andanalyze problemsofFouriertransformtechniques

UNITI:MATRICES

Eigenvalues and Eigen vectors of a real matrix, Characteristic equation, Properties of Eigenvalues and Eigenvectors. Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation. Nature of quadraticforms.   **(12)**

UNITII:VECTORCALCULUS

Vector Calculus: Gradient, divergence and curl, their properties and relations. Gauss divergencetheoremandStoke_stheorem(withoutproof).Simpleapplicationproblems.**(12)**

UNITIII:LAPLACETRANSFORM

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems.   **(12)**

UNITIV:APPLICATIONSOFLAPLACETRANSFORM

Methodsfordetermining inverseLaplaceTransforms,convolutiontheorem,Applicationto differentialequationsandintegralequations.EvaluationofintegralsbyLaplacetransforms.
(12)

UNITV:FOURIERTRANSFORM

FourierIntegraltheorem(statementonly),Fouriertransformanditsinverse,properties.Fouriersineand cosinetransforms,theirproperties,convolutionandParseval_sidentity.**(12)**

TEXT BOOKS:

1. VenkataramanM.K,EngineeringMathematicsTheNationalPublishingCompany,Chennai, 2012.
2. KandasamyP.etal,EngineeringMathematics,Vol.2&3,S.Chand& Co.,NewDelhi.

REFERENCEBOOKS:

1. Veerarajan T., Engineering Mathematics for firstyear, Tata McGraw-Hill, NewDelhi,2008.
2. GrewalB.S.,HigherEngineeringMathematics,KhannaPublishers,NewDelhi,41stEdition, 2011.
3. RamanaB.V.,HigherEngineeringMathematics,TataMcGrawHillNewDelhi,11th Reprint, 2010.
4. ErwinKreyszig, AdvancedEngineeringMathematics,JohnWiley&Sons,NewDelhi.
5. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt.Ltd., New Delhi, 7th Edition, 2010

T108MATERIALSCIENCE   4   0   0   4

COURSEOBJECTIVES

> TounderstandtheimportanceofMaterialScienceasasubjectthatrevolutionized modern day technologies

➢ To understand the significance of material science in the development of new materials and devices for all branches of Engineering

➢ To impart knowledge to the Engineering students about some of the important areas of Materials Science so as to enable them perceive the significant contributions of the subject in Engineering and Technology

6.

COURSEOUTCOMES

> Onsuccessfulcompletionofthemodulestudentswillbeable to:

➢ ApplycoreconceptsinMaterialsSciencetosolveengineeringproblems.

➢ knowledgeableofcontemporaryissuesrelevanttoMaterialsScienceand Engineering.

➢ Selectmaterialsfordesignandconstruction.

➢ Understandthe importance oflife-longlearning.

UNITI: CRYSTALSTRUCTUREANDDEFECTS

Crystal structure - Bravais Lattices , Crystal Systems - Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices- Powder X Ray Diffraction Method.Lattice defects – Qualitative ideas of point, line, surface and volume defects.

(12)

UNITII:DIELECTRICPROPERTIES

Dielectric Polarization and Mechanism –Temperature dependence of polarization, Internal or local Field - Clausius-Mossotti relation. Basic ideas of Dielectric loss - frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric materials and Applications.

(12)

UNITIII:MAGNETICPROPERTIES

Origin of atomic magnetic moment – Bohr magneton-ElementaryIdeas of classification of magneticmaterials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theoryof Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic data storage – Magnetic tapes, Hard disks, Magneto optical recording. (12)

UNITIV:SEMICONDUCTORSANDSUPERCONDUCTORS

Semiconductors -Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of Electrical conductivity in intrinsic and extrinsic semiconductors (without derivations) -temperature dependence of carrier concentration and electrical conductivityin semiconductors (qualitative ideas), Hall effect in Semiconductors --Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V) Superconductivity - Basic concepts – transitiontemperature –Meissener effect – Type Iand IIsuperconductors – High Temperature Superconductors – 123 superconductor – Applications of superconductors. **(12)**

UNITV: ADVANCEDMATERIALS

Liquid Crystals – Types – Application as Display Devices Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications,Shape Memory alloys (SMA), Shape memory effect, Properties and applications of SMA Nanomaterials - Nano materials (one, Two& three Dimensional) –Methods of synthesis (PVD, CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials. carbon nanotubes – synthesis, Properties and applications.   **(12)**

TEXT BOOKS:

1. VRajendran,EngineeringPhysics,2ndEdition,TMH,NewDelhi2011.

REFERENCEBOOKS:

1. AliOmarM,ElementarySolidStatePhysics,AddisonWesleyPublishingCo.,2009.
2. William D Callister Jr., Material Science and Engineering, 6th Edition, JohnWiley and sons, 2009.
3. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley & sons, Singapore, 2007.
4. V Raghavan , Materials Science and Engineering- A First Course, 5thEdition, Prentice Hall of India, 2008.
5. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012
6. M.N. Avadhanulu,EnginerringPhysics-Volume-II, S.Chand&Co,NewDelhi, 2009
7. PillaiS.O,SolidStatePhysics,6thEdition –NewAgeInternational,2005.

T109ENVIRONMENTALSCIENCE   4   0   0   4

COURSEOBJECTIVES
  - ➢ To knowabout theenvironment
  - ➢ Tounderstandaboutenvironmentalpollution
  - ➢ Toapplytheknowledgeinunderstandingvariousenvironmentalissues and problems

COURSEOUTCOMES

Onsuccessfulcompletionofthemodulestudentswillbeable to:
  - ➢ Applyfundamentalknowledgetounderstandabouttheenvironment
  - ➢ Identifyenvironmentalpollutionthroughscience
  - ➢ Applybasicknowledgetosolvevariousenvironmentalissuesandproblems

UNITI:ENVIRONMENTANDENERGYRESOURCES

Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere. Atmospheric layers. Pollution definition and classification.Pollutants classification. Forest resources – use and over exploitation, deforestation,forest management.Water resources – use and conflicts over water, dams -benefits and problems. Mineral resources – mineral wealth of India, environmental effects of extracting and using mineral resources. Food resources – world food problems, environmental impact of modern Agriculture – fertilizer and pesticides. Energy resources – growing needs, renewable and non-renewable energy resources and use of alternate energy sources. From unsustainable to sustainable development. **(12)**

UNITII:ECOSYSTEM& BIODIVERSITY

Concept of an ecosystem - structure and function of an ecosystem. Producers, consumers, and decomposers. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic (fresh water, esturine and marine) ecosystems. Biodiversity – definition, genetic species and ecosystem diversity. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values. Hot spots of biodiversity. Threats to biodiversity, habitat loss, poaching of wildlife, human wildlife conflicts. Endangered and endemic species.Conservation of biodiversity – in-situ and ex-situ conservation of biodiversity. (12)

UNITIII:AIRPOLLUTION

Definition and classification. Chemical and photochemical reaction in different layers of atmosphere. Causes, sources, effects and control measures of air pollutants - oxides of Nitrogen, oxides of Carbon, oxides of Sulfur, hydrocarbons, chloro-fluoro carbons and particulates. Mechanism and effects of air pollution phenomenon – Global Warming, Ozone Depletion, Acid Rain, Sulfurous Smog and Photochemical Smog. **(12)**

UNITIV:WATER ANDLANDPOLLUTION

Water pollution – causes and effects of organic water pollutants – pesticides, insecticides, detergents and surfactants. Causes and effects of inorganic water pollutants – heavy metal pollution due to Hg, Pb, Cr & Cu. Water pollution control and monitoring – DO, COD, BOD & TOC. Land Pollution – Solid waste management – causes, effect and control measures of urban and industrial wastes. Thermal and radioactive pollution. **(12)**

UNITV:POLLUTIONCONTROLANDMONITORING

BasicconceptsandinstrumentationofIR,UV-VIS,atomicabsorptionspectrometry,Gas

Chromatography and Conductometry. Analysis of air pollutants – NOx, COx, SOx, H2S, Hydrocarbonsand particulates. **(12)**

TEXT BOOKS:

1. RaghavanNambiarK.,―TextBookofEnvironmentalStudies‖2ndedition,Scitech Publications, India, Pvt. Ltd, Chennai, 2008.
2. A.K.De,―Environmentalchemistry‖6rdedition;Newageinternational(P)Ltd,New Delhi, 2006

REFERENCEBOOKS:

1. B.K.Sharma,―Environmentalchemistry‖11thEd,KRISHNAPrakashanMedia(P) Ltd, Meerut, 2007.
2. S.S.Dara,andD.D.Mishra―Atextbookofenvironmentalchemistryandpollution control, 5th Ed, S.Chandand Company Ltd, New Delhi, 2012.
3. Richard T. Wright, Environmental Science: Toward a Sustainable Future, 10thedition,Prentice Hall, 2008
4. G.S.Sodhi,Fundamentalconceptsofenvironmentalchemistry,IEd,AlphaScience International Ltd, India, 2000

T104 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING   3   1   0   4

COURSE OBJECTIVES

➢ To understand and gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines

➢ To understand the basic operation, functions and applications of PN junction diode, transistor, logic gates and flipflops.

➢ To understand the measuring devices in electronics.

➢ To gain knowledge on various communication systems and network models.

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ Will gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines

➢ Will gain basic knowledge on instruments for measurements, communication systems and network models.

PART–A- ELECTRICAL

UNIT I: DC CIRCUIT

Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law, Kirchoff's law & its applications – Simple Problems - Division of current in Series & parallel circuits -star/delta conversion- Node and mesh methods of analysis of DC circuits. **(10)**

UNIT II: AC CIRCUIT

Concepts of AC circuits – rms value, average value, form and peak factors -Simple RLC series circuits – Concept of real and reactive power – Power factor-Introduction to three phase system-Power measurement by two wattmeter method. **(10)**

UNIT III : ELECTRICAL MACHINES AND POWER PLANTS:

Law of Electromagnetic induction, Fleming_s Right & Left hand rule - Principle of DC rotating machine, Single phase transformer and single phase induction motor(Qualitative approach only) - Simple layout of thermal and hydro generation (block diagram approach only).Fundamentals of fuses and circuit breakers. **(10)**

PART–B–ELECTRONICS UNIT

IV: ELECTRONIC CIRCUIT

Characteristics of diode - Half-wave rectifier and Full-wave rectifier – with and without capacitor filter -Transistor -Construction & working - Input and output characteristics of CB and CE configuration - Transistor as an Amplifier - Principle and working of Hartley oscillator and RC phase shift oscillator - Construction and working of JFET & MOSFET.

(10)

UNIT V: DIGITAL ELECTRONICS

Boolean algebra – Reduction of Boolean expressions -De-Morgan's theorem – Logic gates - Implementation of Boolean expressions -Flip flops -RS, JK, T and D. Combinational logic - Half adder, Full adder and Subtractors. Sequential logic-Ripple counters and shift registers.

(10)

UNIT VI: COMMUNICATION AND COMPUTER SYSTEMS

Model of communication system - Analog and digital - Wired and wireless channel. Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular mobile system. Network model -PAN, LAN, MAN and WAN -Circuit and packet switching – Overview of ISDN. **(10)**

TEXTBOOKS:

1. KothariDPandNagrathI J, BasicElectrical Engineering , TataMcGrawHill,2009. (For Units I to III)
2. RajendraPrasad,――FundamentalsofElectronicEngineering‖,Cengagelearning,New Delhi, First Edition, 2011 (For Unit IV)
3. MorrisMano,―‖Digitaldesign‖,PHILearning,FourthEdition,2008(For UnitV)
4. Wayne Tomasi, ―-Electronic Communication Systems - Fundamentals Theory Advanced‖, Sixth Edition, Pearson Education, 2004. (For Unit VI)

REFERENCEBOOKS:

1. R.Muthusubramaniam,S.SalivahananandK.A.Mureleedharan,BasicElectricalElectronics and Computer Engineering, Tata McGraw Hill, 2004..
2. J.B.Gupta,ACourse inElectricalPower,KatsonPublishingHouse,New Delhi, 1993.
3. David. A. Bell, ―Electronic Devices and Circuits‖, PHI Learning Private Ltd, India, Fourth Edition, 2008
4. Donald P Leach, Albert Paul Malvino and Goutam Saha, ―Digital Principles and Applications,‖ 6th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi,2008.
5. S.K. Sahdev, Fundamentals of Electrical Engineering and Electronics, Dhanpat Rai & Co, 2013.
6. Jacob Millman and Christos C. Halkias, ―Electronic Devices and Circuits‖ Tata McGraw Hill,2008
7. R.L. Boylestad and L. Nashelsky, ―Electronic Devices and Circuit Theory‖, PHI Learning Private Limited, Ninth Edition, 2008.
8. M.S.Sukhija and T.K.Nagsarkar, ― Basic Electrical and Electronics Engineering‖, Oxford University Press, 2012.

T105 ENGINEERING THERMODYNAMICS   3   1   0   4

COURSE OBJECTIVES
- ➢ To understand the basics of the thermodynamic principles and establish the relationship of these principles to thermal system behaviors
- ➢ To develop methodologies for predicting the system behavior and establish the importance of laws of thermodynamics applied to energy systems
- ➢ To explain the role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

COURSE OUTCOMES
On successful completion of the module students will be able to:
- ➢ Apply knowledge of mathematics, science and engineering to understand the basics of the thermodynamic principles and establish the relationship of these principles to thermal system behaviors
- ➢ Design and conduct experiment, as well as to analyze and develop methodologies for predicting the system behavior and understand the importance of laws of thermodynamics applied to energy systems
- ➢ Identify and analyze role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

UNIT I: BASIC CONCEPTS AND DEFINITIONS
Energy conversion and efficiencies - System, property and state - Thermal equilibrium - Temperature - Zeroth law of Thermodynamics – P, V, and T Diagrams, -Thermodynamic Diagram.   **(12)**

UNIT II: FIRST LAW OF THERMODYNAMICS
The concept of work and adiabatic process - First law of thermodynamics - Conservation of Energy principle for closed and open systems - Calculation of work for different processes of expansion of gases.   **(12)**

UNIT III: SECOND LAW OF THERMODYNAMICS
Equilibrium and the second law - Heat engines - Kelvin-Planck statement of second law of thermodynamics - Reversible and irreversible processes - Carnot principle - Clausius inequality- Entropy.   **(12)**

UNIT IV: GAS POWER CYCLES
Air standard cycles: The air standard Carnot cycle - Air standard Otto cycle, diesel cycle, dual cycle and Bryton cycles and their efficiencies.   **(12)**

UNIT V: REFRIGERATION CYCLES AND SYSTEMS
Reverse Carnot cycle - COP - Vapor compression refrigeration cycle and systems (only theory) - Gas refrigeration cycle - Absorption refrigeration system - Liquefaction and solidification (only theory)   **(12)**

TEXT BOOKS:
1. Nag,P.K.,―EngineeringThermodynamics‖,4th edition,TataMcGrawHill Publishing Co. Ltd., New Delhi,1995

REFERENCEBOOKS:
1. Arora,C.P.,―Thermodynamics‖,TataMcGrawHillPublishingCo.Ltd.,New Delhi,1998.
2. Burghardt,M.D.,―-EngineeringThermodynamicswithApplications‖,4th edition, Harper & Row, N.Y., 1986.
3. Huang,F.F.,―-EngineeringThermodynamics‖2[nd]edition,MacmillanPublishing Co. Ltd., N.Y.,1989.
4. Cengel,Y.A.andBoles,M.A.,"Thermodynamics-AnEngineeringApproach",5th edition, Mc-Graw Hill, 2006
5. Wark,K.,―-Thermodynamics‖,4[th]edition,McGrawHill,N.Y.,1985

T106COMPUTER PROGRAMMING

3 1 0 4

COURSEOBJECTIVES
- ➢ Tointroduce the basicsofcomputersandinformationtechnologyandeducate problem solving techniques.
- ➢ ToimpartprogrammingskillsinC language.
- ➢ Topracticestructuredprogrammingtosolvereallifeproblems.

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
- ➢ Knowconceptsin problem solving
- ➢ Todo programmingin C language
- ➢ TowritediversifiedsolutionsusingC language
- ➢ Toknowaboutstructures,pointersanditsmanipulation.

UNITI
History of Computers – Block diagram of a Computer – Components of a Computersystem – Classification of computers - Hardware – Software – categories of Software – Operating System – Applications of Computers –Network Structure - Internet and its services– Intranet–Studyof word processor– Preparation of worksheets.   **(12)**

UNITII
Problemsolvingtechniques–Program–Programdevelopmentcycle –Algorithmdesign – Flowchart - Pseudo code. Introduction to C – Historyof C – Importance of C - C tokens – data types – Operators and expressions – I/O functions.   **(12)**

UNITIII
Decision making statements – branching and looping – arrays – multidimensional arrays – Functions – Recursion – Passing array to functions .Storage classes – Strings – String libraryfunctions.   **(12)**

UNITIV
Structures–ArraysandStructures–nestedstructures –passingstructurestofunctions –user defined data types– Union. Pointers – pointers and arrays – pointers and functions - pointers and strings - pointers and structures.   **(12)**
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UNITV
Files–operationsonafile–Randomaccesstofiles–commandlinearguments .Introductiontopreprocessor–Macrosubstitutiondirectives–Fileinclusiondirectives – conditional compilation directives – Miscellaneous directives.

(12)

TEXT BOOKS:

1. Balagurusamy.E,―ProgramminginANSIC‖,TataMcGrawHill,12thEdition,2012

REFERENCEBOOKS:

1. VikasVerma,―-AWorkbookonC‖―,CengageLearning,Second Edition,2012
2. AshokNKamthane,―-ComputerProgramming‖,Pearsoneducation,Second Impression, 2008.

COURSEOBJECTIVES
- ➢ Tointroducethebasicsofcomputersandinformationtechnologyandeducate problem solving techniques.
- ➢ ToimpartprogrammingskillsinClanguageandgainahandsonexperienceof compilation and execution of _c' programs.
- ➢ Topracticestructuredprogrammingtosolvereallifeproblems.

COURSEOUTCOMES

Onsuccessfulcompletionofthemodulestudentswillbeable to:
- ➢ Knowconceptsinproblem solving
- ➢ Todo programmingin C language
- ➢ Towrite diversifiedsolutionsusingC language

LISTOFEXERCISES
1. StudyofOSCommands
2. Write a Cprogramtofindthe Area ofthetriangle.
3. WriteaCprogramtofindthetotalandaveragepercentageobtainedbyastudentfor6 subjects.
4. WriteaCprogramtoreada threedigitnumberandproduceoutputlike 1
   hundreds
   7 tens
   2unitsfor an input of172.
5. WriteaCprogramtocheckwhetheragivencharacterisvowelornotusingSwitch – Case statement.
6. Writea Cprogramtoprintthe numbersfrom1to10alongwiththeirsquares.
7. WriteaCprogramtofindthesumof__n_numbersusingfor,do –whilestatements.
8. Writea Cprogramtofindthefactorialofa givennumberusingFunctions.
9. Writea Cprogramtoswaptwonumbersusingcallbyvalue andcallbyreference.
10. Writea Cprogramtofindthe smallestandlargestelementinanarray.
11. WriteaCprogramtoperformmatrix multiplication.
12. WriteaCprogramtodemonstratetheusageofLocalandGlobalvariables.
13. WriteaCprogramtoperformvariousstringhandlingfunctions:strlen,strcpy,strcat, strcmp.
14. WriteaCprogramtoremoveallcharactersina stringexceptalphabets.
15. Writea Cprogram tofindthesumofaninteger arrayusingpointers.
16. Writea CprogramtofindtheMaximumelementinanintegerarrayusingpointers.
17. WriteaCprogramtocreatestudentdetailsusingStructures.
18. Writea C programtodisplaythe contentsof the file on themonitorscreen.
19. Createa Filebygettingtheinputfromthekeyboardandretrieve the contents of the file using file operation commands.
20. Writea Cprogramtopassthe parameterusingcommandline arguments.

P102 ENGINEERING GRAPHICS   2 0 3 2

COURSE OBJECTIVES
- To convey the basics of engineering drawing
- To explain the importance of an engineering drawing
- To teach different methods of making the drawing
- To establish the importance of projects and developments made in drawing that
- are used in real systems
- To explain the role of computer aided design _AutoCad
- To develop an intuitive understanding of underlying significance of using these Drawings

COURSE OUTCOMES
On successful completion of this course, the student will be able to familiarize with the fundamentals and standards of Engineering graphics
- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Project orthographic projections of lines and plane surfaces.
- Draw projections and solids and development of surfaces.
- Visualize and to project isometric and perspective sections of simple solids.

UNIT I
Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning.

UNIT II
Conic sections, Involutes, Spirals, Helix, Projection of Points, Lines and Planes Projection of Solids and Sections of Solids.

UNIT III
Development of surfaces - Intersection of surfaces (cylinder-cylinder, cylinder-cone)

UNIT IV
Isometric projections and Orthographic projections

UNIT V
Computer Aided Drafting: Introduction to Computer Aided Drafting hardware - Overview of application software - 2D drafting commands (Auto CAD) for simple shapes - Dimensioning

TEXT BOOKS:
1. Gopalakrishna K.R. and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.

REFERENCE BOOKS:
1. Bhatt N.D., Engineering Drawing, 49th edition, Chorotar Publishing House, 2006.
2. Venugopal K., Engineering Drawing and Grahics + AutoCAD, 4th edition, New Age International Publication Ltd., 2004 .
3. David Icook and Robert N McDougal, Engineering Graphics and Design with computer applications, Holt – Sounders Int. Edn. 1985.
4. James D Bethune and et.al., Modern Drafting, Prentice Hall Int., 1989
5. Natarajan K.V., A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
6. BIS, Engineering Drawing practice for Schools & College, 1992.

P103 BASIC ELECTRICAL AND ELECTRONICS LABORATORY   0   0   3   2

COURSE OBJECTIVES
➢ To get an exposure on the basic electrical tools, applications and precautions
➢ To gain training on different types of wiring used in domestic and industrial applications.
➢ To detect and find faults in electrical lamp and ceiling fan
➢ To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistor
➢ To gain a practical knowledge on the functions and application of basic logic gates and flip flops

COURSE OUTCOMES
On successful completion of this course, Students will be able to,
➢ Know about basic electrical tools, applications and precautions
➢ Perform different types of wiring used in domestic and industrial applications
➢ Measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistor
➢ Understand the functions and application of basic logic gates and flip flops

ELECTRICAL LAB
LIST OF EXPERIMENTS
1. Electrical Safety, Precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor's room wiring.
6. Bedroom wiring.
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuits breakers and A.C and D.C meters.

ELECTRONICS LAB
LIST OF EXPERIMENTS
1. Study of CRO
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou's figures)
2. Verification of Kirchoff's Voltage and Current Laws
   Determine the voltage and current in given circuits using Kirchoff's laws theoretically and verify the laws experimentally.
3. Characteristics and applications of PN junction diode.
   Forward and Reverse characteristics of PN junction diode.
   Application of Diode as Halfwave Rectifier –Measurement of ripple factor with and without capacitor filter
4. Frequency Response of RC Coupled Amplifiers
   Determination of frequency response of given RC coupled amplifier -Calculation of bandwidth.
5. Study of Logic Gates
   (a) Verification of Demorgan's theorems
   (b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR gates and Flipflops-JK, RS, T and D
   (c) Implementation of digital functions using logic gates and Universal gates.

P 107NSS/NCC

NCC/NSStrainingiscompulsoryfor allUndergraduatestudents

1. TheactivitieswillincludePractical/fieldactivities/Extensionlectures.
2. Theactivitiesshallbecarriedoutoutsideclass hours.
3. Fortheaboveactivities,thestudentparticipationshallbeforaminimumperiodof 45 hours.
4. TheactivitieswillbemonitoredbytherespectivefacultyinchargeandtheFirst Year Coordinator.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years
6. Passin thiscourse ismandatoryfortheawardof degree.

RAT31LINEARALGEBRA   **3 1 0 4**

COURSEOBJECTIVES
- ➢ Tointroducethebasicnotionsofgroups,rings,fieldswhichwillbeusedtosolve related problems.
- ➢ Tofamiliarizetheapplicationsofalgebraicstructures.
- ➢ To understand the concepts of vector space, linear transformations and diagonalization.
- ➢ Toapplytheconcept ofinner product spacesin orthogonalization.

COURSEOBJECTIVES
Onsuccessfulcompletionofthemodulestudentswillbeableto:
- ➢ Understand the concepts and properties of algebraic structures such as groups, ringsand fields.
- ➢ Demonstrateaccurateandefficientuseofadvancedalgebraictechniques.
- ➢ Demonstrate their mastery by solving non- trivial problems related to the conceptsand by proving simple theorems.

UNITI:GROUPS
Algebraic systems – Semi groups - Monoids – Groups – Subgroups – Homomorphism's – Normalsubgroupandcosets– Lagrange'stheorem. **(12)**

UNITII:RINGSANDFIELDS
Rings -Sub-rings -Propertiesofrings– Fields-Integraldomain -IdealsandQuotientrings – Polynomial rings. **(12)**

UNITIII:VECTORSPACES
Vector spaces – Subspaces – Linear combinations andlinear system of equations – Linear independenceandlineardependence–Basesanddimensions. **(12)**

UNITIV:LINEARTRANSFORMATIONANDDIAGONALIZATION
Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigen values and eigenvectors - Diagonalizability. **(12)**

UNITV:INNERPRODUCT SPACES
Inner product- Norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation. **(12)**

TEXTBOOKS:
1. HowardAntonandChrisRorres,―ElementaryLinearAlgebra‖,JohnWiley&Sons, New Delhi, 2011.
2. DavidCLay,―LinearAlgebraanditsApplications‖,PearsonEducation,NewDelhi, 2012.
3. StephenHFriedberg,LawrenceESpence,ArnoldJInsel,― LinearAlgebra‖,Pearson, 4th edition, 2015
4. I.N.Herstein,―TopicsinAlgebra‖,JohnWiley&Sons,NewDelhi,2006.

REFERENCES:
1. GlynJames,DavidBurely,PhilDyke,DickClements,NigelSteele,JohnSearlandJerry Wright―AdvancedModernEngineeringMathematics‖,PearsonEducation,15thedition 2018.

2.   Kolman,B.Hill,D.R.,—IntroductoryLinearAlgebra‖,PearsonEducation,NewDelhi, First Reprint,
     2009.
3.   Kumaresan,S.,—LinearAlgebra-AGeometricApproach‖,Prentice–HallofIndia,New Delhi,
     Reprint,2010.
4.   Lay,D.C.,—LinearAlgebraanditsApplications‖,5thEdition,PearsonEducation,2015.
5.   Strang,G.,—LinearAlgebraanditsapplications‖,Thomson(Brooks/Cole),NewDelhi, 4th
     edition, 2006.

RAT32–ELECTRONICDEVICESANDCIRCUITS   4   0   0   4

COURSEOBJECTIVES
- Tointroducetheconceptsofelectronballistics,thephysicsofsemiconductorsand various parameters of diodes.
- To learn and gain insight into the operation, characteristics and functional aspects of BJT, JFET, MOSFET, several special semiconductor devices.
- To design the different types of biasing in BJT, FET and MOSFET and analyzevarious rectifier circuits with filters and IC regulator circuits

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
- Apply knowledgescienceandengineering tounderstandsemiconductordiodes, diode equation and characteristics.
- ToanalyzefunctionalaspectsofBJT,JFET,MOSFETanditsbiasing.
- Designandconstructsimplecircuitslikerectifiers,filtersandICregulators.

UNITI:SEMICONDUCTORDIODES
PNjunctiondiode–operation,forward,reversebiascharacteristics-theoryofdiodecurrent - diode equation - temperature effects – DC and AC resistance – diode equivalent circuit– transitionanddiffusioncapacitance–diodeswitchingtime–Avalancheand Zener breakdown – Zener diode characteristics.   **(12)**

UNIT II: BIPOLAR JUNCTION TRANSISTOR
PNP and NPN transistors – transistor current components – characteristics of transistor in CB, CE, CC configurations –Amplifier-Oscillator- Early effect - Ebers-Moll model. Field Effect Transistors **-** JFET – construction – operation - drain and transfer characteristics – current equations – pinch-off voltage and its significance. MOSFET – construction, operation and characteristics of EMOSFET, DMOSFET and VMOSFET.   **(12)**

UNIT III: SPECIAL SEMICONDUCTOR DEVICES
Construction, principle of operation and characteristics of Schottkybarrier diode, Varactor diode, Tunnel diode, PIN diode, LED, LCD, UJT, SCR, DIAC and TRIAC. Photoconductivity – photodiode, APD, phototransistor, LDR, optocoupler, solar cell, LASER diode and MESFET.   **(12)**

UNITIV:BIASINGANDSTABILIZATION
DC loadlineand Q-point –Needfor biasing– Differenttypes of BJT biasing – Fixed bias, Collector to base bias, Self bias –Stability factor Bias compensation: Diode, Thermistor and Sensistor compensation – FET biasing: Gate bias, Voltage divider biasand Self bias – MOSFETbiasing.   **(12)**

UNITV:POWERSUPPLY
Rectifiers – Halfwave, Full wave andbridge rectifier – RipplefactorcalculationforC, L, LCandCLCfilter.Voltageregulators –Shuntvoltageregulator –Seriesvoltageregulator – Short circuit protectioncircuit – Currentlimitingcircuit – Foldbacklimiting– Op-Amp voltage regulator – Switching regulator – Step up and step down converters.   **(12)**

TEXT BOOKS:
1. Jacob Millman and Christos C. Halkias, ―Integrated Electronics‖ Tata McGraw-Hill,Second Edition, 2009.
2. R.L.BoylestadandL.Nashelsky,―ElectronicDevicesandCircuitTheory‖, Pearson Education, Tenth Edition, 2009.

REFERENCEBOOKS:
1. DavidA.―BellElectronicDevicesandCircuits‖,Oxforduniversitypress,5th Edition, 2010.
2. DonaldANeaman,―SemiconductorPhysicsandDevices‖,TataMcGraw-Hill, Third Edition, 2007
3. S.Salivahanan,N.SureshKumarandA.Vallavaraj,ElectronicDevicesand Circuits, 2nd Edition, TMH, 2007.

RAT33PROGRAMMINGINPYTHON   4   0   0   4

COURSEOBJECTIVES
- ➢ ToreadandwritesimplePython programs.
- ➢ TodevelopPythonprogramswithconditionalsandloops.
- ➢ Todefine Pythonfunctionsanduse them.
- ➢ TousePythondatastructures –-lists,tuples,dictionaries.
- ➢ Todoinput/outputwithfilesinPython.

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
- ➢ Read,writeandexecute simple programsbyPython
- ➢ StructuresimplePythonprogramsforsolvingproblems.
- ➢ DecomposeaPythonprograminto functions.
- ➢ RepresentcompounddatausingPythonlists,tuples,dictionaries.

UNITI:BASICS
Python - Variables - Executing Python from the Command Line - Editing Python Files - Python Reserved Words - Basic Syntax-Comments - Strings and Numeric Data Types - Simple Input and Output..   **(12)**

UNITII:CONTROLSTATEMENTS
Control Flow and Syntax - Indenting - If Statement - Relational Operators - Logical Operators - Bit Wise Operators - while Loop - break and continue - for Loop - Lists –Tuples - Sets - Dictionaries.   **(12)**

UNITIII:FUNCTIONS
Definition - Passing parameters to a Function - Variable Number of Arguments - Scope - Passing Functionsto a Function -Mapping Functionsin a Dictionary– Lambda -Modules - Standard Modules – sys – math – time - Dir Function.   **(12)**

UNITIV:ERRORHANDLING
RunTimeErrors-ExceptionModel-ExceptionHierarchy-HandlingMultipleExceptions
- Data Streams - Access Modes Writing - Data to a File Reading - Data from a File - Additional File Methods - Using Pipes as Data Streams - Handling IO Exceptions -Working with Directories.   **(12)**

UNITV:OBJECTORIENTEDFEATURES
ClassesPrinciplesofObjectOrientation-CreatingClasses-InstanceMethods-FileOrganization-SpecialMethods-ClassVariables–Inheritance–Polymorphism-Type Identification-SimpleCharacterMatches-SpecialCharacters-CharacterClasses– Quantifiers -Dot Character - GreedyMatches – Grouping -Matchingat Beginning or End - Match Objects – Substituting - Splitting a String - Compiling Regular Expressions.   **(12)**

TEXT BOOKS:
1. MarkSummerfield.―Programming inPython3:A Completeintroductiontothe Python Language‖, Addison-Wesley Professional, 2009.
2. MartinC.Brown,―PYTHON:TheCompleteReference‖,McGraw-Hill,2001.

REFERENCEBOOKS:
1. WesleyJ Chun,―CorePythonApplicationsProgramming,PrenticeHall,2012.
2. AllenBDowney,―ThinkPython‖,O_Reilly,2012.

RAT34SENSORSANDINSTRUMENTATION   4   0   0   4

COURSEOBJECTIVES
➢ Tounderstandtheconceptsofmeasurement technology.
➢ Tolearnthe varioussensorsusedtomeasure variousphysicalparameters.
➢ To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

COURSEOUTCOMES:
Onsuccessfulcompletionofthemodule,studentswillbeableto:
➢ Use the concepts in common methods for converting a physical parameter into anelectrical quantity
➢ Classifythe transducersandexplainitwithexamplesformeasurementof temperature, strain, motion, position and light
➢ Choosepropersensorbycomparingdifferentstandardsandguidelinestomake sensitive measurements of physical parameters like pressure, flow, acceleration, etc
➢ Predicttheexpectedperformanceofvarioussensors

UNITI:INTRODUCTION
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristicsof transducers – Performance measuresof sensors – Classification ofsensors – Sensor calibration techniques – Sensor Output Signal Types. **(12)**

UNITII:MOTION,PROXIMITYANDRANGINGSENSORS
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth,Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). **(12)**

UNITIII:FORCE,MAGNETICANDHEADINGSENSORS
Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages. Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers. **(12)**

UNITIV:OPTICAL,PRESSUREANDTEMPERATURESENSORS
Photoconductivecell,photovoltaic,Photoresistive,LDR – Fiberopticsensors–Pressure– Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors. **(12)**

UNITV:SIGNALCONDITIONINGANDDAQSYSTEMS
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channeland multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring. **(12)**

TEXT BOOKS:
1. ErnestODoebelin,―MeasurementSystems–ApplicationsandDesign‖,TataMcGraw-Hill, 2009
2. SawneyAKandPuneetSawney,―ACourseinMechanicalMeasurementsand Instrumentation and Control‖, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCEBOOKS:

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley& Sons, Canada, 2001
2. HansKurtTönshoff(Editor),Ichiro,―SensorsinManufacturing‖Volume1,Wiley- VCH April 2001.
3. JohnTurnerandMartynHill,―InstrumentationforEngineersandScientists‖,Oxford Science Publications, 1999.
4. PatranabisD,―SensorsandTransducers‖,2ndEdition,PHI,NewDelhi,2011.
5. RichardZurawski,―IndustrialCommunicationTechnologyHandbook‖2ndedition, CRC Press, 2015.

RAT35 ELECTRICAL MACHINES AND DRIVES 　　　　3　1　0　4

COURSE OBJECTIVES
- To understand the operations of DC and AC machines.
- To analyze the performance of the special machines for different appliances.
- To study the basics of the Electric Drives unit
- To understand the operation and performance of conventional and solid state speed control of DC and AC drives

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Acquire knowledge on DC and AC machines.
- Know the features of the Synchronous and Special Machines
- Learn the different types of Electric Drives
- Acquire knowledge on DC and AC drives.

UNIT I: ELECTRICAL MACHINES
Mechanical characteristics- speed- torque characteristics of various types of load and drive motors - braking of electrical motors - DC motors: shunt, series, compound motors-single phase and three phase induction motors Transformers: Construction and Principle of operation – Single Phase transformer – Introduction to 3 phase transformers. **(12)**

UNIT II: SYNCHRONOUS AND SPECIAL MACHINES
Construction of Synchronous machines - Types – Induced emf – Working principles of Brushless alternators – Stepper motor - Servomotor – Universal motor - Applications – rating and duty cycle -Sizing of Motor for a Industrial application. 　　　　**(12)**

UNIT III: ELECTRIC DRIVES
Basic elements-types of electric drives-factors influencing electric drives-heating and cooling curves -loading conditions and classes of duty-Selection of power rating for drive motors with regard to thermal overloading and load variation factors. 　　　　**(12)**

UNIT IV: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C DRIVES
Conventional and solid state speed control of D.C Drives - Speed control of DC series and shunt motors-Armature and field control, Ward-Leonard control system using controlled rectifiers and DC choppers –applications. 　　　　**(12)**

UNIT V: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF AC DRIVES
Conventional and solid state speed control of AC drives -Speed control of induction motor-Voltage control, voltage/frequency control, slip power recovery scheme-using inverters and AC voltage regulators-applications. 　　　　**(12)**

TEXT BOOKS:
1. B.L.Theraja,―ElectricalTechnologyVol.IIAC/DCMachines‖,S.Chand,2008.
2. VedamSubramaniam,―ElectricDrives–Conceptsandapplications‖,TataMcGrawHill Publishing Co., Ltd., New Delhi 2003
3. G.K.Dubey, ―FundamentalsofElectricDrives"Alpha ScienceInternationalLtd. 2001.
4. R.Krishnan,―ElectricMotor&Drives:Modelling,AnalysisandControl‖,PrenticeHall of India, 2001.

REFERENCEBOOKS:
1. J.B.Gupta,―TheoryandPerformanceofElectricalMachines‖,J.K.Kataria&Sons,13th edition,2004.
2. Bimal K. Bose, ―Modern Power Electronics and AC Drives", Prentice-hall of India Pvt. Ltd, 2005.
3. M.H.Rashid,"PowerElectronicCircuits,DevicesandApplications",PrenticeHall International, 2007 Edition, Newness Publications, 2006.
4. H.Partab, ―Art and science and utilization of electrical energy‖, Dhanpat Rai and Sons, 1994.

RAT36 STRENGTH OF MATERIALS   3   1   0   4

COURSE OBJECTIVES
- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the selection of materials used for making components for robotics.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Understand the concepts of stress and strain in simple and compound bars, importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressure
- To analyze the type of materials and its suitability as per applications.

UNIT I: STRESS, STRAIN AND DEFORMATION OF SOLIDS
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.   **(12)**

UNIT II: TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM
Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.   **(12)**

UNIT III: TORSION
Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.   **(12)**

UNIT IV: DEFLECTION OF BEAMS & CYLINDERS
Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems, Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders **(12)**

UNIT V: MATERIALS FOR ROBOTICS:
Robotics /Design Basics/Building Materials – Metal, synthetic materials and composite materials – properties of steel from steel construction – properties of wrought aluminum alloys – Mechanical Properties of stainless steel – Designation of Titanium alloys – structural examination of titanium alloys – case hardening of titanium and alloys-How to build robots using advanced materials – Case study.   **(12)**

TEXT BOOKS:

1. Bansal,R.K.,"StrengthofMaterials",LaxmiPublications(P)Ltd., 2016
2. JindalU.C.,"StrengthofMaterials", AsianBooksPvt.Ltd.,NewDelhi,2009

REFERENCEBOOKS:

1. Egor.P.Popov―EngineeringMechanicsofSolids‖PrenticeHallofIndia,New Delhi, 2002
2. FerdinandP.Been,RussellJohnson,J.r.andJohnJ.Dewole"Mechanicsof Materials", Tata McGraw Hill Publishing _co. Ltd., New Delhi, 2005.
3. Hibbeler,R.C.,"MechanicsofMaterials",PearsonEducation,LowPriceEdition, 2013
4. Subramanian R., "Strength of Materials",Oxford University Press, OxfordHigher Education Series, 2010.
5. MikellGrover.,―IndustrialRobotics‖,McGrawHill,2016.

RAP31ELECTRONICDEVICESANDCIRCUITSLABORATORY   0   0   3   2

COURSEOBJECTIVES

- ➢ Tounderstandtheoperationofsemiconductor devices.
- ➢ Tounderstand DCanalysisandACmodelsofsemiconductordevices.
- ➢ TodesignofRegulatorsandAmplifiers
- ➢ To verify the theoretical concepts through laboratory and simulation experiments.
- ➢ Toexecuteminiprojectsbasedonimplementationofelectroniccircuitsconcept.

COURSEOUTCOMES
Aftersuccessfulcompletionofthecoursestudentwillbeableto
- ➢ Understandthevoltage-currentcharacteristicsofsemiconductor devices
- ➢ AnalyzeDCcircuitsandrelateACmodelsofsemiconductordeviceswiththeir physical Operation
- ➢ Designandanalyzethevariouselectroniccircuits

1. V-Icharacteristicsofsemiconductordiodes
   a) PNJunctiondiode
   b) Pointcontactdiode
   c) Zenerdiode
2. CharacteristicsofBJTinCBconfiguration
   a) Determinationofinputandoutputcharacteristics
   b) Determinationofvoltagegain,currentgain,inputandoutput resistances from the characteristics
3. CharacteristicsofBJTinCEconfiguration
   a) Determinationofinputandoutputcharacteristics
   b) Determination ofvoltagegain, current gain, input andoutputresistances from the characteristics
4. CharacteristicsofJFET
   a) Determinationofoutputandtransfercharacteristics
   b) Determinationofpinchoffvoltage,r_d,$g_m$andµfromthecharacteristics
5. CharacteristicsofMOSFET
   a) Determinationofoutputandtransfercharacteristics
   b) Determinationofpinchoffvoltage,r_d,$g_m$andµfromthecharacteristics
6. CharacteristicsofUJT, SCRandTRIAC
7. Characteristicsofphotonicdevices
   a) DeterminationofV-IcharacteristicsofLED
   b) DeterminationofV-Iandintensitycharacteristicsofphototransistor
8. Designandtestingofbiasingcircuits
   a) Fixedbias
   b) Collectortobasebias
   c) Selfbias
9. RectifierandVoltage Regulators
   a) Determinationofripplefactorfordifferenttypesofrectifierswith and without filters.
   b) Voltageregulationcharacteristicsofshunt,seriesandICregulators
10. i)Clippercircuitsusingdiodes
    Positive,negative,biasedandcombinationalclippers
    ii) Switchingcircuit
    a) ANDandORlogicgatesusingdiodes
    b) NOTgateusingtransistor

RAP32PROGRAMMINGINPYTHONLABORATORY　　　　**0　0　3　2**

COURSEOBJECTIVES
- LearnSyntax,SemanticsandcreateFunctionsinPython.
- HandleStringsandFilesinPython.
- UnderstandLists,DictionariesandRegularexpressionsinPython.
- ImplementObjectOrientedProgrammingconceptsinPython
- BuildWebServicesandintroductiontoNetworkandDatabaseProgrammingin Python.

COURSEOUTCOMES
Aftersuccessfulcompletionofthecoursestudentwillbeableto
- Examine Python syntax, semanticsand befluentin usingof Python flowcontroland functions.
- DemonstrateproficiencyinhandlingStringsandFile Systems.
- Create, run and manipulate Python Programs using core data structures likeLists,Dictionaries and use Regular Expressions.
- InterprettheconceptsofObject-OrientedProgrammingasusedin Python.
- Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

LISTOFEPERIMENTS:
1. WriteaPythonprogramtofindGCDoftwonumbers.
2. Writea PythonProgram tofindthe squareroot ofa numberbyNewton'sMethod
3. Writea Pythonprogramtofindthe exponentiationofa number.
4. WriteaPythonProgramtofindthemaximumfromalistofnumbers.
5. WriteaPythonProgramtoperformLinear Search
6. WriteaPythonProgramtoperformBinarySearch
7. WriteaPythonProgramtoperformselectionsort.
8. WriteaPythonProgramtoperforminsertionsort.
9. WriteaPythonProgramtoperformMergesort.
10. WriteaPythonprogramtofindfirstNprime numbers.
11. WriteaPythonprogramtomultiplymatrices.

RAP33 ELECTRICAL MACHINES AND DRIVES LABORATORY   0   0   3   2

COURSE OBJECTIVES
- ➢ To understand the basics of electrical machines and trigger circuits required for various power converters.
- ➢ To acquire knowledge about the operation of various power converter circuits like Controlled rectifiers, Choppers, AC voltage regulators and Inverters.

COURSE OUTCOMES
- ➢ The course enables the students to do simulation of the circuits using MATLAB/Simulink and experimentally verify the simulation results in the hardware lab. Besides, the students are introduced with some of the application of the power converters.

LIST OF EXPERIMENT
1. Study of thyristors controlled DC Drive.
2. Study of Chopper fed DC Drive.
3. Study of AC Single phase motor-speed control using TRIAC.
4. PWM Inverter fed 3 phase Induction Motor control using MATLAB/PSIM Software.
5. VSI/CSI fed Induction motor Drive analysis using MATLAB/PSIM Software.
6. Study of V/f control operation of 3phase induction motor drive.
7. Study of Permanent Magnet Synchronous Motor drive fed by PWM Inverter using Software.
8. Regenerative/Dynamic braking operation for DC Motor-Study uses software.
9. Regenerative/Dynamic braking operation of AC motor-study uses software.
10. PC based AC/DC motor control operation.

RAT41FOURIERSERIESANDPARTIALDIFFERENTIAL EQUATIONS   3   1   0   4

COURSEOBJECTIVES
- Tointroducethebasicconceptsforsolvingstandardpartialdifferentialequations.
- ToprovidetheconceptofFourierseriesandexpandingfunctionsintoFourier series including Harmonic analysis.
- To make the students knowledgeable in the areas of BoundaryValue Problems likevibratingstring(waveequation),Heatequationinoneandtwodimensions.

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeabletounderstand:
- Howtosolvethe givenstandardpartialdifferentialequations.
- ThephysicalsignificanceofFourierseriestechniquesinsolvingone,two dimensional heat flow problems and one dimensional wave equations.

UNITI:FOURIERSERIES
Dirichlet'sconditions–General Fourierseries –Periodic -OddandEvenfunctions – Half Range Sine Series – Half Range Cosine Series.   **(12)**

UNITII:
Root Mean Square Value – Parseval'stheorem on Fourier Coefficients -Complex form of Fourier series – Harmonic Analysis.   **(12)**

UNITIII:PARTIALDIFFERENTIALEQUATIONS
Formation of PDE by elimination of arbitrary constant and arbitrary function – General , Singular , particular and complete integrals - Lagrange's linear first order equation - Higher order PDE with constant coefficients of both homogeneous and non-homogeneous types.   **(12)**

UNITIV:APPLICATIONOFFOURIERSERIES
Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solution – Transverse vibration of an elastic string.   **(12)**

UNITV:
Fourier series solution for one dimensional heat flow equation – Fourier seriessolutions for two dimensional heat flow equations under steady state condition – (Cartesian and Polar forms) (excluding proof).   **(12)**

TEXT BOOKS:
1. Grewal B.S., ―Higher Engineering Mathematics", 43rd Edition, KhannaPublishers, New Delhi, 2014.

2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics forEngineering Students",Vol. II & III, S.Viswanathan Publishers Pvt. Ltd,Chennai, 1998.

REFERENCES:

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" Prentice Hall India Learning Pvt Ltd, 2003.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. ErwinKreyszig,"AdvancedEngineeringMathematics",10thEdition,JohnWiley, India, 2016.
4. James,G.,"AdvancedModernEngineeringMathematics",3rdEdition,PearsonEducation, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie,R.C.andBarrett,L.C.,―AdvancedEngineeringMathematics―Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

RAT42PRINCIPLESOF ROBOTICS   4   0   0   4

COURSEOBJECTIVES
- Tointroduce thefunctionalelementsofRobotics
- Toimpartknowledgeonthedirectandinversekinematics
- Tointroduce themanipulatordifferentialmotionandcontrol
- Toeducate onvariouspathplanningtechniques
- Tointroducethe dynamicsandcontrolofmanipulators

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
- Abilitytounderstandbasic conceptof robotics.
- ToanalyzeInstrumentationsystemsandtheirvariousapplications.
- Toknowaboutthe differentialmotionaddstaticsinrobotics
- Toknowaboutthevariouspathplanningtechniques.
- Toknowaboutthedynamicsand control in robotics industries

UNITI:BASICCONCEPTS
Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.
(12)

UNITII:DIRECTANDINVERSEKINEMATICS
Mathematical representation of Robots - Position and orientation – Homogeneous transformation-Various joints- Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution. **(12)**

UNITIII:MANIPULATORDIFFERENTIALMOTIONANDSTATICS
Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse - Wrist and arm singularity - Static analysis - Force and moment Balance. **(12)**

UNITIV:PATH PLANNING
Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning. **(12)**

UNITV:DYNAMICSAND CONTROL
Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. **(12)**

TEXT BOOKS:
1. R.K.MittalandI.J.Nagrath,RoboticsandControl,TataMcGrawHill,New Delhi,4th Reprint, 2005.
2. JohnJ.Craig,IntroductiontoRoboticsMechanicsandControl,Thirdedition,Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCEBOOKS:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K.K.Appu Kuttan,Robotics,IKInternational,2007.
3. EdwinWise,AppliedRobotics,CengageLearning,2003.
4. R.D.Klafter,T.A.ChimielewskiandM.Negin,RoboticEngineering–AnIntegrated Approach, Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai, 1998.
6. S.Ghoshal,―EmbeddedSystems&Robotics‖–Projectsusingthe8051 Microcontroller‖, Cengage Learning, 2009.

RAT43ANALOGAND DIGITAL ELECTRONICS　　　　**4　0　0　4**

COURSEOBJECTIVES

- ➢ Tointroduce thetheoryandapplicationsof analogmultipliersand PLL
- ➢ TolearnthetheoryofADCand DAC
- ➢ Tounderstandthe fundamentalsofnumbersystems,Booleanalgebra,Simplification of Boolean Function and Karnaugh map method.
- ➢ TounderstandtheconceptsofCombinationalandSequential LogicDesign.
- ➢ Toconceptualize thelogic familiesand PLDs.

COURSEOUTCOMES

Onsuccessfulcompletionofthemodulestudentswillbeable to:

- ➢ DesignlinearandnonlinearapplicationsofOP–AMPS
- ➢ DesignapplicationsusinganalogmultiplierandPLL
- ➢ DesignADCandDACusingOP–AMPS
- ➢ To implement number systems, Boolean algebraand Karnaugh map,Simplification method in the design of digital systems.
- ➢ Design and analyze Combinational and Sequential Logic Design and Programmable Logic Devices.
- ➢ Design and construct Combinational Logic circuits and Synchronous Sequential Circuits.

UNITI:FUNDAMENTALSOFANALOGANDDIGITAL ELECTRONICS

ANALOG ELECTRONICS: Functional Block Diagram – Circuit symbol, Pin Configuration – The ideal OPAMP - Open loop gain, Inverting and Non-inverting amplifiers, Voltage follower, Differential amplifier, CMRR, slew rate – DC Characteristics - AC Characteristics. APPLICATIONS- Summing amplifier, Subtractor, Integrator and Differentiator - V-I and I-V converters, Comparator – Regenerative comparator, Zero crossing detector, Window detector, Sample and hold circuit, Rectifiers

DIGITAL ELECTRONICS: Boolean Algebra: Computer codes – BCD, Gray code, Excess3code,Errordetectionandcorrectioncodes.Booleanalgebra　–　BasicPostulatesand theorems, Switching functions, Canonical forms, Logic gates. Simplification of logic functions through K – maps and Implementation using logic gates.　　　　**(12)**

UNITII :SPECIAL FUNCTION ICs: 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, 566 Voltage Controlled Oscillator.PLLFunctionalBlockdiagram　　–Principleofoperation,Applications:Frequency synthesis, DC Motor speed control.

IC VOLTAGE REGULATORS: Block diagram of 723 general purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting, Fixed and adjustable three terminal regulators.　　　　**(12)**

UNIT III : A-D AND D-A CONVERTERS: Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/DConverters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter usingVoltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.　　　　**(12)**

UNITIV:COMBINATIONALANDSEQUENTIALLOGICDESIGN

COMBINATIONAL LOGIC DESIGN: Binary / BCD adders and subtractors, Decoders, Encoders, Multiplexers and Demultiplexers, Magnitude comparator, ALU.

SEQUENTIAL LOGIC DESIGN: Latch, Flip Flops, Level triggering, Edge triggering, Master slave configuration. Shift register, Binary counters, Ring counter, Johnson counter. Mealy/Moore state machines. **(12)**

UNITV:DIGITALLOGICFAMILIESAND PLDS
DIGITAL LOGIC FAMILIES -Characteristics of digital IC's -TTLlogic family– Totem pole, Open collector and tristate outputs. MOS transistor switches –nMOS Inverter / Logic gates, CMOS logic, Inverter / logic gates. ECL logic families – Comparison of performance of various logic families.
PROGRAMMABLE LOGIC DEVICES: Introduction to PLDs – ROM, PAL, PLA, FPGA, ASIC. **(12)**

TEXT BOOKS:
1. GayakwadAR,―OP-AmpsandLinearIntegratedcircuits‖,PearsonEducation,New Delhi, 2004.
2. SedraandSmith,―MicroelectronicCircuits‖,OxfordUniversityPress,2004.
3. VTocciRJ,WidmerNSandMossGL,―DigitalSystems:Principlesandapplications‖, Pearson Education (Singapore) Pvt. Ltd, 2010.
4. NelsonVP,NagleHT,CarrollBD,andIrwinJD,―DigitalLogicCircuitAnalysis and Design‖, Prentice Hall International Inc., New Jersey, 1995.

REFERENCEBOOKS:
1. CoughlinFR,andDriscollFF,―OperationalAmplifiersandLinearIntegrated Circuits‖, Prentice Hall of India, New Delhi, 1997.
2. RoyChoudhuryandShailJain,―LinearIntegratedCircuits‖,NewAge International Limited, 2003.
3. Leach D P, Malvino A P and Goutam Saha, ―Digital Principles and Applications‖, Tata Mc Graw – Hill, 2010.
4. DonaldGivone,―DigitalPrinciplesandDesign‖,TataMcGraw–HillEdition, 2003.
5. Floyd,―DigitalFundamentals‖,PrenticeHallofIndia,NewDelhi,2014.

COURSEOBJECTIVES

- ➢ To acquire a fundamental understanding of linear and digital control systems and their design.
- ➢ Tounderstandtheconceptsofcontrolsystemcomponentsandmathematical modeling of electrical system, mechanical system, etc.
- ➢ Tostudytheconcept oftimeresponseandfrequencyresponseof thesystem.
- ➢ An understanding of the concept of marginal stability, asymptotic stability andbounded-input bounded-output stability for continuous and discrete systems.
- ➢ TopioneerthebasicsofdifferentplotssuchasBodeplot,Nyquistplot,Root locus method and Polar plot.
- ➢ To familiarize the theoryof Z-transform, inverse Z-transform and their properties in the digital control system.

COURSEOUTCOMES

Onsuccessfulcompletionofthemodulestudentswillbeable to:

- ➢ Understandanddemonstrate discrete,digital,linearcontrol systems.
- ➢ Explainsampling,quantization,encodingandtheirmathematicalmodeling.
- ➢ Explaineffectsofcommon nonlinearitiesintroducedin asystem.
- ➢ Understand Z transform, pulse transfer function and able to apply that conceptfor digital system analysis.
- ➢ Abletoanalyzedigitalsystemandnonlinearsystemstabilityusingdifferent analysis tools.

UNITI:SYSTEMMODELING

Introduction to control system-Basic elements of control system- Open and Closed loop control systems-Differential equation representation of physical systems-Transfer function-Mathematical modeling of electrical and mechanical systems (Translational andRotational)-Analogous system-Block diagram reduction techniques- Signal flow graph.

(12)

UNITII:TIMEDOMAIN ANALYSIS

Time response analysis-Analysis of transient and steady state behavior of control systems-Standard test signals –Time response of First order system- step, ramp and impulseresponse analysis-Second order system – step response analysis- steady state error- generalized error co-efficient–Response with P, PI, PD and PID controllers-Analysis using MATLAB. **(12)**

UNITIII:FREQUENCYDOMAINANALYSIS

Frequency response-Frequency domain specifications- Correlation between time domain and frequencydomain specifications-Bode plot- Stabilityanalysis using Bode plot- transfer functionfromBodeplot-Polarplot-AnalysisusingMATLAB. **(12)**

UNITIV:STABILITY ANALYSISANDROOT LOCUS:

Concepts of stability-Location of poles on s-plane for stability-Routh-Hurwitz stability criterion-Nyquist stability criterion-Root locus Techniques-Analysis using MATLAB. **(12)**

UNITV:DIGITALCONTROL SYSTEM

Basic digital control system-Z transform and its properties- Inverse Z transform-Responseof linear discrete time systems-Pulse transfer function- Stability analysis-Jury_s stability criterion.StateSpaceAnalysis:Statespacemodelofacontrolsystem-Statespace

representationusingphysical,phaseandcanonicalvariables-diagonalcanonicalform-Jordan canonical form. **(12)**

TEXT BOOKS:

1. Benjamin.C.Kuo, ―Digital control systems‖, Second Edition, OxfordUniversityPress, 2012.
2. I.J.Nagrath,M.Gopal,―ControlSystemsEngineering‖,FifthEdition,NewAge International,NewDelhi,2011.

REFERENCEBOOKS:

1. R.Anandanatarajan,P.RameshBabu,―ControlSystemsEngineering‖,Secondedition ,Scitech Publications, 2005.
2. Benjamin C. Kuo, ―Automatic Control Systems‖, Seventh Edition, PHI Learning, New Delhi, 1997.
3. Katsuhiko Ogata, ―Discrete Time Control Systems‖, Second Edition, PHI Learning, New Delhi, 2006.

RAT45KINEMATICSANDDYNAMICSOF MACHINCES   4   0   0   4

COURSEOBJECTIVES
- ➢ Tounderstandthebasicknowledge aboutkinematicsofmachines.
- ➢ Tounderstandthebasiccomponentsandlayoutoflinkagesintheassemblyofa system/ machine.
- ➢ Tounderstandtheprinciplesinanalyzingtheassemblywithrespecttothe displacement, velocity, and acceleration at any point in a link of a mechanism.
- ➢ Tounderstandthemotionresultingfromaspecifiedsetoflinkages,designfew linkage mechanisms and cam mechanisms for specified output motions.
- ➢ To understand the basic concepts of toothed gearing and kinematics of gear trainsand the effects of friction in motion transmission and in machine components.

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
- ➢ Understandthebasicknowledgeofkinematicsof machines
- ➢ Studentscanabletoapplyfundamentalsofmechanismforthedesignofnewmechanisms
- ➢ Abletoknowaboutthelinkages,designfewlinkagemechanismsandcam mechanisms for specified output motions.
- ➢ Impartknowledgeaboutthegearsandgear trains.
- ➢ Abilitytoanalyze themforoptimumdesign

UNITI:KINEMATICOF MACHINES
Mechanisms – Terminologyand definitions – kinematics inversions of 4 barand slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analyticalmethods   –computerapproach–cams–classifications–displacementdiagrams   - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.   **(12)**

UNITII:GEARSandGEARTRAINS
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.   **(12)**

UNITIII:FRICTION
Sliding and Rolling Friction angle – friction in threads – Friction Drives –Belt and rope drives.   **(12)**

UNITIV:KINEMATICSOFCAMMECHANISMS
Classification of cams and followers – Terminology and Definitions – Displacement Diagrams- Uniform velocity , Parabolic , Simple Harmonic and cycloid motions – Derivatives of follower motions – Layout of plate cam profiles – SpecifiedContourcams – Circular arc and tangent cams – Pressure angle and undercutting – Sizing of cams.**(12)**

UNITV:BALANCINGANDVIBRATION
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency– Damped Vibration bending critical speed of simple shaft.   **(12)**

TEXT BOOKS:
1. AmbekarA.G.,―MechanismandMachineTheory‖PrenticeHallofIndia,New Delhi, 2007
2. ShigleyJ.E., Pennock G.R and UickerJ.J., ―Theoryof MachinesandMechanisms‖, Oxford University Press, 2003

REFERENCEBOOKS:
1. ThomasBevan,―TheoryofMachines‖,CBSPublishersandDistributors,1984.
2. Ghosh.A,andA.K.Mallick,―TheoryandMachine‖,AffiliatedEast-WestPvt.Ltd., New Delhi, 1988.
3. Rao.J.S.andDukkipattiR.V.―MechanismsandMachines‖,Wiley-EasternLtd., New Delhi, 1992.
4. JohnHannahandStephensR.C.,―MechanicsofMachines‖,VivaLowPrices Student Edition, 1999.
5. V.Ramamurthi,MechanismsofMachine,NarosaPublishingHouse,2002.
6. RobertL.Norton,DesignofMachinery,McGraw-Hill,2004.

RAT46 HYDRAULICS AND PNEUMATICS   4 0 0 4

COURSE OBJECTIVES
- To provide student with knowledge on the application of fluid power in process Construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Understand the Fluid power and operation of different types of pumps.
- Summarize the features and functions of Hydraulic motors, actuators and Flow control valves.
- Understand the Different types of Hydraulic circuits and systems.
- Understand the working of different pneumatic circuits and systems.
- Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

UNIT I: FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.   **(12)**

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors -Control Components :Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.   **(12)**

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.   **(12)**

UNIT IV: PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS
Properties of air– Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.   **(12)**

UNIT V: TROUBLESHOOTING AND APPLICATIONS
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.   **(12)**

TEXT BOOKS:
1. AnthonyEsposito,―FluidPowerwithApplication‖,PearsonEducation(Singapore) Pvt. Ltd, Delhi, India, 2003.
2. MajumdarS.R.,―OilHydraulicsSystems-PrinciplesandMaintenance‖,Tata McGraw-Hill, 2001.
3.

REFERENCEBOOKS:
1. AnthonyLal,―Oilhydraulicsintheserviceofindustry‖,Alliedpublishers,1982.
2. Dudelyt,A.PeaseandJohnT.Pippenger,―BasicFluidPower‖,PrenticeHall,1987.
3. Majumdar S.R., ―Pneumatic systems – Principles and maintenance‖, Tata McGraw Hill, 1995
4. MichaelJ,PrinchesandAshbyJ.G,―PowerHydraulics‖,PrenticeHall,1989.
5. Shanmugasundaram.K,―HydraulicandPneumaticcontrols‖,Chand&Co,2006.

RAP41 ANALOG AND DIGITAL ELECTRONICS LABORATORY   0   0   3   2

COURSE OBJECTIVES

- To supplement the design concepts in analog electronics.
- To understand how to design combinational and sequential circuits.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Ability to design linear integrated circuits and its applications
- Ability to design combinational and sequential circuits.

LIST OF EXPERIMENTS
1. Applications of Op-amp
   To study the application of Op-amp IC 741 as
      a. Inverting amplifier
      b. Non-inverting amplifier
      c. Voltage follower
      d. Summer
      e. Subtractor
2. Differentiator and Integrator
   To study the op-amp performance as differentiator and integrator for various time constants
3. Comparator circuits and Signal converters
      a. To study zero crossing detector, window detector using Op-amp 741
      b. To study operation of op-amps as V to I and I to V converters
4. Data converters
   Construction and study performance of
      a. DAC circuits – R-2R and ladder type.
      b. Successive approximation type ADC.
5. Study of 555 Timer and 566 VCO.
6. Performance characteristics of Voltage Regulator ICs.
7. Design and implementation of the following Code convertors
   a. BCD to excess-3 code and vice versa
   b. Binary to gray code and vice-versa
8. Design of Multiplexers and Encoders
9. Design of Decoders and Demultiplexers
10. Shift register
    Study of a universal shift registers IC
11. Construction of Ring counter and Johnson counter using a shift register IC and study of their timing diagrams

RAP42KINEMATICSANDDYNAMICSLABORATORY　　　　　**0　0　3　2**

COURSEOBJECTIVES
- ➢ TosupplementtheprincipleslearntinkinematicsandDynamicsof Machinery.
- ➢ Tounderstandhowcertainmeasuringdevicesareusedfordynamic testing.

COUSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
- ➢ Abilitytodemonstratetheprinciplesofkinematicsanddynamicsofmachinery
- ➢ Abilityto usethemeasuringdevicesfor dynamictesting.

LISTOFEXPERIMENTS:
1. a)Studyofgear parameters.
    b) Experimentalstudyofvelocityratiosofsimple,compound,Epicyclicand differential gear trains.
2. a)KinematicsofFour Bar,SliderCrank,CrankRocker,Doublecrank,Doublerocker, Oscillating cylinder Mechanisms.
    b) Kinematicsofsingleanddoubleuniversaljoints.
3. a)DeterminationofMassMomentofInertiaofFlywheelandAxle system.
    b) DeterminationofMassMomentofInertia ofaxisymmetricbodiesusingTurnTable
    c) DeterminationofMassMomentofInertiausingbifilarsuspensionandcompound pendulum.
4. Motorizedgyroscope–Studyofgyroscopic effectandcouple.
5. Governor -Determinationofrangesensitivity, effortetc.,forWatts,Porter,Proell,and Hartnell Governors.
6. Cams–Camprofile drawing,Motioncurvesandstudyofjumpphenomenon
7. a)SingledegreeoffreedomSpringMassSystem–Determinationofnatural Frequencyand verification of Laws of springs – Damping coefficient determination.
    b) Multidegreefreedomsuspensionsystem–Determinationofinfluence coefficient.
8. a)Determinationoftorsionalnaturalfrequencyof singleandDoubleRotorsystems.- Undamped and Damped Natural frequencies. b) Vibration Absorber – Tuned vibration absorber.
9. VibrationofEquivalentSpringmasssystem–undampedanddampedvibration.
10. Whirlingofshafts–Determinationofcriticalspeedsofshaftswithconcentrated loads.
11. a)Balancingofrotatingmasses. (b)Balancingofreciprocatingmasses.
12. a)TransversevibrationofFree-Free beam–withandwithoutconcentratedmasses.
    b) ForcedVibrationofCantileverbeam–Modeshapesandnaturalfrequencies.
    c) Determinationoftransmissibilityratiousingvibratingtable.

RAP43HYDRAULICSANDPNEUMATICSLABORATORY   **0   0   3   2**

COURSEOBJECTIVES
➢ To familiarize the fluid power automation and different components of Hydraulics, pneumatics, electro hydraulic/ electro pneumatic and PLC based systems
➢ Handsonexperienceindesignandexecutionofcircuitsforrealsystems

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
➢ Explain the similarities and differences of the electrical, pneumatic and hydraulic systems, can decide which system is better for a specific application,
➢ Explain the basic parts of the industrial hydraulic and pneumatic systems and their functions, can design a hydraulic or pneumatic system circuit by using related software and make simulations,
➢ Design a hydraulic or pneumatic system and outline PLC control algorithm for a predefined automation process.

LISTOFEXPERIMENTS
1. Simulationofbasichydraulic,pneumaticandelectrical circuits.
2. Studyof Electro pneumaticcircuits.
3. Simulationofelectro-pneumaticcircuitsusingmicroprocessor.
4. Modelingandanalysisofbasichydraulic,pneumaticandelectricalcircuitsusing AUTOMATIONSTUDIO'Software.
5. Studyofvarioustypesof transducers.
6. Studyofvarioussignalconditioningcircuits.
7. OpenandclosedloopcontrolofACandDCdrives.
8. Studyof PLC and itsapplications.

SPP44 PHYSICAL EDUCATION   0 0 0 0

Physical Education iscompulsoryfor all the Undergraduate studentsand Passinthis course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 45 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

RAT51-STATISTICSANDNUMERICALMETHODS   3   1   0   4

COURSEOBJECTIVES
- ➢ This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- ➢ To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- ➢ To introduce the basic concepts of solving algebraic and transcendental equations.
- ➢ To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- ➢ To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

COURSEOUTCOMES
- ➢ Apply theconceptof testing of hypothesis forsmalland largesamples in reallife problems.
- ➢ Apply the basic concepts of classifications of design of experiments in the field ofagriculture.
- ➢ Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniquesof differentiationand integration forengineeringproblems.
- ➢ Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- ➢ Solvethepartialandordinarydifferentialequationswithinitialandboundaryconditions by using certain techniques with engineering applications.

UNITI:TESTINGOF HYPOTHESIS
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit. **(12)**

UNITII:DESIGNOFEXPERIMENTS
One wayand two wayclassifications - Completelyrandomized design – Randomized block design – Latin square design -factorial design. **(12)**

UNITIII:SOLUTIONOFEQUATIONSANDEIGENVALUE PROBLEMS
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvaluesofa matrixbyPowermethodandJacobi'smethodforsymmetric matrices.**(12)**

UNIT IV: INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules. **(12)**

UNIT V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Single step methods : Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods : Milne's and Adams - Bash forth predictor corrector methods for solving first order equations. **(12)**

TEXTBOOKS:
1. Grewal. B.S. and Grewal. J.S., ―Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. **Johnson,R.A.,Miller,IandFreundJ.,―MillerandFreund'sProbabilityandStatistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.**
3.

REFERENCEBOOKS:
1. Burden, R.L and Faires, J.D, "Numerical Analysis‖, 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probabilityand Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis‖ Pearson Education, Asia, New Delhi, 2006.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., ―Probabilityand Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

RAT52 MICROCONTROLLER AND EMBEDDED SYSTEM DESIGN   4   0   0   4

COURSE OBJECTIVES
- To understand the architectures and the instruction set of 8085, 8086, 8051
- To learn the assembly language program using 8085, 8086 and 8051 instruction set
- To learn interfacing of microprocessors and microcontrollers with various peripheral
- To introduce embedded systems, its hardware, software, devices and buses used for embedded networking.

COURSE OUTCOMES
On successful completion of this course students will be able to:
- Interpret the architecture & instruction set of 8085, 8086, 8051 microcontroller to develop assembly language programs
- Illustrate the application of 8051 microcontroller on chip peripherals to implement the functions of I/O port, timer/Counter, serial port & interrupts.
- Demonstrate the peripheral devices 8255 PPI and 8279 for integrating keyboard, 7 segment display, LCD display and traffic light controller & 8259 PIC for handling multiple interrupts I/O
- Design 8051 Microcontroller based systems for measuring electrical and physical quantities & Motor control. Interpret the hardware and software components of an embedded system for an application and infer the architecture and programming model of ARM processor.
- Infer the instruction set and exception types of ARM processor to develop Assembly language programs

UNIT I: INTEL 8085 MICROPROCESSOR
Intel 8085 Hardware - Architecture – Pin description and addressing modes; Intel 8086 Hardware – Pin description and addressing modes; Intel 8051 Microcontroller: Introduction – Architecture – Memory Organization – Special Function Registers – Pins and Signals – Timing and control – Port Operation – Memory and I/O interfacing – Interrupts –Instruction Set and Programming. **(12)**

UNIT II: ON-CHIP PERIPHERALS & PERIPHERAL DEVICES
I/O Port Programming - Timer Registers -Timer Modes - Overflow Flags - Clocking Sources -Timer/ Counter Interrupts – Timer Programming - Baud Rate Generation - Serial Port Register -Modes of Operation - Serial Port Programming- Interrupt Organization- Processing Interrupts - Interrupt Programming- Programmable Peripheral Interface (8255) - Keyboard / Display Controller (8279) - Programmable Interrupt Controller (8259).**(12)**

UNIT III: DESIGN OF MICROCONTROLLER BASED SYSTEM
Voltage, Current and Frequency Measurement-DC Motor Control- Stepper Motor control -Case Studies: Arduino Board Overview-Arduino IDE-Temperature Control.**(12)**

UNIT IV: EMBEDDED SYSTEMS & ARCHITECTURE OF ARM PROCESSOR
Processor Embedded into a system - Embedded Hardware units and devices in a system - Embedded Software in a System -Classification of Embedded Systems - Embedded Design Life Cycle -Design Example:Model Train Controller. ARM Embedded System -CISC and RISC Processors - ARM Architecture - Programming Model - Operating Modes.**(12)**

UNIT V: ARM PROGRAMMING
ARM Instruction Set - ARM Instruction Types:Data Transfer, Data Processing and Control Flow Instructions -Interrupts–Exceptions types -NVIC Registers for interrupt control**.(12)**

TEXT BOOKS:

1. Krishna Kant,―MicroprocessorsandMicrocontrollers –Architectures,Programming and System Design 8085, 8086, 8051, 8096‖, PHI, 2014.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems Using Assembly and C ", 2nd Edition, Pearson Education 2013.
3. Kenneth J. Ayala, "The 8051 Microcontroller. Architecture, Programming and Applications", 3rd Edition, West publishing company 2014
4. Andrew N.Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide:Designing and Optimizing System Software", Morgan Kaufmann Publishers, 1st Edition, 2004.
5. Raj Kamal, "Embedded Systems Architecture, Programming and Design", Tata McGraw Hill, 2nd Edition, 2009

REFERENCEBOOKS:

1. Soumitra Kumar Mandal "Microprocessors and Microcontrollers Architecture Programming and Interfacing using 8085, 8086 & 8051" Tata McGraw Hill Publishing Co Ltd, 1st Edition, 2011.
2. Myke Predko, "Programming and Customizing the 8051 Microcontroller", 1st Edition, 2012.
3. ChrisBraith,"8051MicrocontrollerApplicationbasedIntroduction",Elsevier2004.
4. ManishKPatel,"The8051MicrocontrollerBasedEmbeddedSystems"Tata McGraw Hill Publishing Co Ltd, Ist Edition, 2014.
5. JonathanWValvano,"EmbeddedSystems:IntroductiontoArm®CortexTM-M Microcontrollers", 5th Edition, 2015.
6. Shibu K.V, "Introduction to Embedded Systems", Tata Mc Graw Hill, 1st Edition,2009.
7. Jean J.Labrosse, "Embedded Systems Building Blocks", CMP Books, 2nd Edition, 2010.

RAT53PROGRAMMABLELOGIC CONTROLLERS   4 0 0 4

COURSEOBJECTIVES
- ToprovideknowledgelevelsneededforPLC programmingand operating.
- TomakethestudentsunderstandhowdevicesareconnectedwithPLCinputand output modules.
- Totrainthestudentstocreate ladderdiagramsfromprocesscontroldescriptions.
- TomakethestudentsunderstandvarioustypesofPLCregisters
- ApplyPLC Timersand Countersforthecontrol of industrial processes
- TomakethestudentsunderstandPLCfunctions,DataHandling Function
- Totrainthestudentstodevelopa—coilandcontact‖controlsystemtooperatea basic robot and analog PLC operations.

COURSEOUTCOMES
AbilitytogainknowledgeonProgrammableLogicControllers
- ThestudentswilllearnaboutthedesignofsystemsusingProgrammable Logic Controllers
- ToknowaboutthedifferentapplicationsofProgrammableLogic Controllers
- WillunderstanddifferenttypesofDevicestowhichPLCinputandoutputmodules are connected
- Toprovidetheknowledgeaboutunderstandvarioustypesof PLC registers
- Abletocreateladderdiagramsfromprocesscontroldescriptions.
- Abilityto applyPLC timersand countersfor thecontrol of industrialprocesses
- AbletousedifferenttypesPLC functions,DataHandlingFunction.
- Abletodevelop a—coilandcontact‖controlsystemtooperateabasicrobotand analog PLC operations.

UNITI: INTRODUCTIONTOFACTORY&PROCESSAUTOMATION
Industrial Versions - Control elements of Industrial Automation- IEC/ ISA Standards for Control Elements – Selection criteria for control elements- Construction of Relay Ladder logicwithdifferentcontrolelements-NeedforPLC-PLCevolution.   **(12)**

UNITII:PROGRAMMABLELOGICCONTROLLERS
Architecture of PLC - Types of PLC – PLC modules, PLC Configuration -Scan cycle - Capabilities of PLC- Selection criteria for PLC – PLC Communication with PC and software- PLC Wiring- Installation of PLC and its Modules.   **(12)**

UNITIII:PROGRAMMINGOFPLC
Types of Programming – Bit Instructions -Timers and counters– PLC arithmeticfunctions PTO / PWM generation- High Speed Counter – Analog Scaling – Encoder Interfacing-Servo drive control – Stepper Motor Control.   **(12)**

UNITIV:HMISYSTEMS
Need for HMI in Industrial Automation, Types of HMI – Configuration of HMI, Screen development and navigation, Configuration of HMI elements / objects and Interfacing with PLC.   **(12)**

UNITV:NETWORKING
PLC Networking- Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet -CAN Open**.** APPLICATIONS OF PLC: Case studies of manufacturingautomationandProcess automation.   **(12)**

TEXT BOOKS:

1. W.Bolton,―Programmablelogiccontrollers‖,ElsevierLtd,2015.
2. FrankDPetruzella,―Programmablelogiccontrollers‖,McGraw-Hill,5thEd,2016..

REFERENCEBOOKS:

1. JohnRHackworthandFredrickDHackworthJr.,―ProgrammableLogic Controllers: Programming Methods and Applications‖, Pearson Education, 2015.
2. SIMATICProgrammingwithSTEP7,SIEMENSManual,2014.

RAT54ROBOTICCONTROL SYSTEMS　　　3　1　0　4

COURSEOBJECTIVES
- ➢ Tointroduce the overviewof robotic systemsandtheir dynamics
- ➢ Toimpartknowledgeonsystemstability
- ➢ Toacquireknowledgeonjointspaceandtaskspacecontrolschemes
- ➢ Tounderstandtheconceptofnonlinearcontrolandobserverschemes

COURSEOUTCOMES
Onsuccessfulcompletionofthe modulestudentswillbeableto:
- ➢ Understandbasicconceptofroboticsystemsandtheir dynamics.
- ➢ Analyzesystemstabilityandtypesofstability
- ➢ Knowaboutjointspaceandtaskspacecontrol schemes
- ➢ Understandtheconceptofnonlinearcontrolandobserver schemes

UNITI:INTRODUCTIONANDOVERVIEWOFROBOTICSYSTEMSAND THEIR DYNAMICS
Forward and inverse dynamics. Properties of the dynamic model and case studies. Introduction to nonlinear systems and control schemes.　　　　　　　**(12)**

UNITII:SYSTEMSTABILITYAND TYPESOFSTABILITY
Lyapunovstabilityanalysis,bothdirectandindirectmethods. Lemmasandtheoremsrelated to stability analysis.　　　　　　　**(12)**

UNITIII:JOINTSPACEANDTASKSPACECONTROL SCHEMES
Position control, velocitycontrol, trajectorycontroland forcecontrol.　　　**(12)**

UNITIV:NONLINEARCONTROLSCHEMES
Proportional and derivative control with gravity compensation, computed torque control, sliding mode control, adaptive control, observer based control, robust control and optimal control.　　　　　　　**(12)**

UNITV:NONLINEAROBSERVERSCHEMES:
Design based on acceleration, velocity and position feedback. Numerical simulations using software packages namely MATLAB/MATHEMATICA.　　　　　**(12)**

TEXT BOOKS:
1. RKelly,D.Santibanez,LPVictorandJulioAntonio,―ControlofRobot Manipulators in Joint Space‖, Springer, 2005.
2. ASabanovicandKOhnishi,―MotionControlSystems‖,JohnWiley&Sons(Asia), 2011
3.

REFERENCEBOOKS:
1. RMMurray, Z. LiandSSSastry,―AMathematicalIntroductiontoRobotic Manipulation‖, CRC Press, 1994.
2. JJCraig,―IntroductiontoRobotics:MechanicsandControl,PrenticeHall,4thEd, 2018.

RAT55 CNC MACHINE AND METROLOGY   4 0 0 4

COURSE OBJECTIVES
➢ Understand evolution and principle of CNC machine tools
➢ Write simple programs for CNC turning and machining centres
➢ Generate CNC programs for popular CNC controllers
➢ Describe about linear and angular measurements in metrology
➢ Study about the advancement in metrology

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ To understand about the basic in CNC machineries
➢ Understand Evolution and principle of CNC machine tools and different measurement technologies. Able to write simple programs for CNC machinery
➢ Impart knowledge about linear and angular measurements in metrology
➢ Know about the advancement in metrology

UNIT I: INTRODUCTION TO CNC MACHINE TOOLS
Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection, CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways.   **(12)**

UNIT II: DRIVES AND WORK HOLDING DEVICES
Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.   **(12)**

UNIT III: CNC PROGRAMMING
Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.   **(12)**

UNIT IV: LINEAR AND ANGULAR MEASUREMENTS
Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology– procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar–Angle alignment telescope–Autocollimator– Applications.   **(12)**

UNIT V: ADVANCES IN METROLOGY
Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications –Basic concepts of Machine Vision System–Element – Applications.   **(12)**

TEXT BOOKS:
1. M.D.Singh, J.G.Joshi, ―Mechatronics‖, HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.

2. WarrenS.Seamers,―ComputerNumericControl‖,FourthEdition,ThomsonDelmar, 2002.
3. JainR.K. ―EngineeringMetrology‖,KhannaPublishers,2005.
4. Gupta.I.C.,―EngineeringMetrology‖,DhanpatraiPublications,2005.

REFERENCEBOOKS:

1. Charles Reginald Shotbolt, ―Metrologyfor Engineers‖, 5th edition, Cengage Learning EMEA,1990.
2. Backwith,Marangoni,Lienhard,―MechanicalMeasurements‖,PearsonEducation, 2006.
3. PeterSmid,―CNCProgrammingHandbook‖,IndustrialPressInc.,2000
4. BerryLeathan–Jones,―IntroductiontoComputerNumericalControl‖,Pitman,London, 1987.
5. RadhakrishnanP―ComputerNumericalControlMachines‖,NewCentralBook Agency, 2002.

RAP51MICROCONTROLLERANDEMBEDDEDSYSTEMDESIGN   0   0   3   2
LABORATORY

COURSEOBJECTIVES
➢ Toenablethestudentstoprogram,simulateandtestthe8085,8051,PIC18and ARM processor basedcircuits and their interfaces
➢ Introducestudentstoembeddedsystemsdesigntoolsandhardwareprogrammers

COURSEOUTCOMES
Uponcompletionofthiscoursethestudentswillbeabletodemonstrateanabilityto
➢ Develop 8051 Assembly Language Programs for Arithmetic, Logic, Bit manipulation, String operations and
➢ Demonstrate an application for 8051 microcontroller using Traffic light controller, ADC & DAC interfacing boards
➢ Demonstrate8051EmbeddedCCodingforProgrammingtheGPIO,Timer, Interrupts & Serial Port and a system for
➢ temperaturemonitoringusingArdiunotargetBoard
➢ Developcommunicationskillsandcapabilitytoworkinteam

LISTOFEXPERIMENTS:
MicrocontrollerLab:

DevelopingAssemblyLanguageProgramsusing8051 MicrocontrollerKits
➢ DatamanipulatingOperationsandDelayRoutines
➢ Stringoperations
➢ InterfacingTrafficlightcontroller
➢ InterfacingADC
➢ InterfacingDAC

EmbeddedLaboratory

1. VoltageMeasurementwithdisplay
    Designing avoltmeter to measure voltage from 0 to 5 volts and displaying themeasured value using 7 segment displays
2. DesignofWaterPumpControllertosensethewaterlevelina tank
3. DigitalClockwithLCDdisplay
4. TemperatureMeasurementwith7segmentdisplay
5. PC Communication
    Interfacing the microcontroller to a PC through RS232 interface and displaying the messages sent by the microcontroller on the PC using Visual Basic program running in PC
6. RemoteControlthroughFMLink
    EstablishinganFMlinkbetweentwomicrocontrollersfordatatransfer.
7. HotChamberControllertomaintainthetemperature atthesetpoint.
8. ObstacleDetectorusingultrasonictransmitter-receiver
9. Moisturesensorandsprinklercontrollerdesign
10. Designingalampcontrollerhavingalightsensorandatimer

RAP52PLCAND ROBOTICSLABORATORY   0   0   3   2

COURSEOBJECTIVES

Tointroducedifferenttypesofroboticsanddemonstratethemtoidentifydifferentpartsand components.

➢ Towriteprogrammingforsimple operations.
➢ UnderstandingthewiringdiagraminterfacingwithI/Oelements.
➢ Designanddevelopmentofladderdiagramsforvariousapplications.
➢ Interfacingandprogrammingformotorcontrol using PLC

COURSEOUTCOMES

Onsuccessfulcompletionofthemodulestudentswillbeable to:

➢ DevelopmentofladderlogicdiagramusingBitInstructions.
➢ PLCbasedCrane control.
➢ PLCbasedparkingstationusingCounterandBitInstructions.
➢ AnalogSensorinterfacingwith PLC.
➢ EncoderinterfacingwithPLC.
➢ Steppermotor/Servo motorcontrol using PLC
➢ Upon Completion of the course, the students will be able to use of any robotic simulation software to model the different types of robots and calculate work volume for different robots

LISTOFEPERIENTS: PLC

1. DevelopmentofladderlogicdiagramusingBitInstructions.
2. PLCbasedCrane control.
3. PLCbasedparkingstationusingCounterandBit Instructions.
4. AnalogSensorinterfacingwithPLC.
5. EncoderinterfacingwithPLC.
6. Steppermotor/Servo motorcontrol usingPLC.

ROBOTICS

1. Forward and Inverse kinematics of two axis planar articulated robot using analytical and DH algorithm using Lego NXT.
2. ForwardandInverse kinematicstocontrolhandmovementsinNAO.
3. StudyandselectionofGripper.
4. Implementation of trajectory planning algorithm for straight line motion using Matlab and executing PID based control of two axis planar articulated robot in Lego NXT.
5. Analysis and Simulation using Fanuc Robo guide software and real time Programming of Fanuc M 710i robot.
6. ProgrammingofAdeptCobraS600SCARArobot.

RAP53CNC ANDMETROLOGYLABORATORY   **0   0   3   2**

COURSEOBJECTIVES
- ToimpartknowledgeinCNC programmingfor turningand millingoperations
- Tousemeasuringsystemsforthegeometricalmeasurementsofgearsandthreads.
- ToknowthemeasurementofTaperAngleusingSineBar

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:
- AbilitytounderstandthefeaturesandoperationofCNCmachines.
- Abilityto prepare CNC program from thecomponent drawings
- Understandingthe usageofprofileprojectorsandtoolmakersmicroscopes.

LISTOFEXPERIMENTS:
1. Studyof theCNC machine
2. ProgrammingandsimulationofalatheusinganyCAMpackage
3. Programmingandsimulationofamachiningcentre usinganyCAMpackage
4. Programmingandoperation ofa CNCLathe
5. Programmingandoperationofa CNCmachiningcentre
6. MeasurementofTaperAngleusingSine Bar
7. Opticalprofile projector–studyofprofile ofgeartooth,screwthreads.
8. Toolmaker'smicroscope–tostudycuttingtoolgeometry,screwthreads.
9. Toolwearandsurfacefinishmeasurement.
10. Dimensionalmeasurementofmachinedcomponentsusing,boregauge,airgauge and Height master.

HSP54GENERALPROFICIENCY-I   **0   0   3   1**

COURSEOBJECTIVES
  - ➢
  - ➢
  - ➢ Thecourse aimsto:Enhancethe EmployabilityandCareerSkillsofstudents
  - ➢ Orientthe studentstowardsgroomingasa professional
  - ➢ MakethemEmployable Graduates.
  - ➢ Developtheirconfidenceandhelpthemattendinterviewssuccessfully.

COURSEOUTCOMES
  Onsuccessfulcompletionofthemodulestudentswillbeable to:
  - ➢ Attheendofthecourse Learnerswillbeable to:
  - ➢ Makeeffective presentations
  - ➢ Participateconfidentlyin Group Discussions.
  - ➢ Attendjobinterviewsandbesuccessfulinthem.
  - ➢ DevelopadequateSoftSkillsrequiredforthe workplace

UNITI: ARTOFCOMMUNICATION
Verbal and Non-verbal Communication – Barriers to Communication – Importance of Body Language – Effective Listening – Feedback.

UNITII:INTRODUCTIONTOSOFTSKILLS
Attitude – Self-Confidence – Leadership Qualities – Emotional Quotient – Effective Time Management Skills – Surviving Stress – Overcoming Failure – Professional Ethics – Interpersonal Skills.

UNITIII:WRITING
Importance of Writing – Written Vs Spoken Language – Formal and Informal Styles of writing – Resources for improving writing – Grammar and Usage – VocabularyBuilding – SWOT analysis.

UNITIV:SPEAKINGPRACTICE
Dialogue – Telephone Etiquette – Public Speaking – Debate – Informal Discussions – Presentations

UNITV:APTITUDE
VerbalandNumericalaptitude.

REFERENCEBOOKS:
1. Nicholls,Anne.MasteringPublicSpeaking.JaicoPublishing House,2003.
2. Aggarwal,R.S.QuantitativeAptitude.S.Chand&Co.,2004.
3. Leigh, Andrew and Michael Maynard. The Perfect Leader. Random HouseBusiness Books,1999.
4. Whetton.A.DavidandKimS.Cameron.DevelopingManagementSkills.Pearson Education, 2007.
5. K.R.Lakshminarayan.DevelopingSoftSkills.Scitech,2009.
6. SherfieldMRobert.DevelopingSoft SkillsPearsonEducation, 2005.
7. Hair O_ Dan, Friedrich W. Gustav and Lynda Dee Dixon. Strategic Communication in Business and the Professions. Pearson Education,2008.
8. Chaney Lilian and Jeanette Martin. Intercultural Business Communication,Fourth Edition. Pearson Education, 2008.

RAT61MODELINGAND SIMULATION   **3   1   0   4**

COURSEOBJECTIVES
- ➢ To provide an overview of how computers are beingused in mechanical component design with the use of various CAD standards
- ➢ To introduce the concepts of Mathematical Modellingof EngineeringProblems using FEM with 2D scalar and vector variables problems respectively.

COURSEOUTCOMES
     Onsuccessfulcompletionofthemodulestudentswillbeable to:
- ➢ knowthebasic conceptsofmodellingandassemblyfordifferentmechanicalcomponents
- ➢ knowthe differenttypesofCADstandardsusedinmodelingofmechanicalcomponents
- ➢ knowaboutbasicconceptsofFEAandanalysissoftwareforanalyzingmechanical components
- ➢ knowaboutdifferentmathematicaltechniquesusedinfiniteelementanalysistosolve structural and thermal problems

UNITI:MODELLINGANDASSEMBLEY
Assemblymodelling–Interferencesofpositionsandorientation–Toleranceanalysis-Mass propertycalculations–Mechanismsimulationandinterferencechecking.   **(12)**

UNITII:CADSTANDARDS
Standards for computer graphics- Graphical Kernel System (GKS) - Standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards.   **(12)**

UNITIII:INTRODUCTIONTOANALYSIS
Basic concepts of the Finite Element Method - Discretization -Meshing – Mesh refinement- Mesh Enrichment- Natural co-ordinate systems -Types of elements- Special Elements- Crack tip Element- Introduction to Analysis Software.   **(12)**

UNITIV:TWODIMENSIONALSCALARVARIABLEPROBLEMS
Second Order 2DEquationsinvolving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems.   **(12)**

UNITV:TWODIMENSIONALVECTORVARIABLEPROBLEMS
Equations of elasticity – Plane stress, plane strain and axisymmetric problems– Body forces and temperatureeffects –Stresscalculations-Plateandshellelements.   **(12)**

TEXT BOOKS:

1. IbrahimZeid―MasteringCADCAM‖TataMcGraw-HillPublishingCo.2007
2. Rao,S.S.,―TheFiniteElementMethodinEngineering‖,5thEdition,Butterworth Heinemann, 2010

REFERENCEBOOKS
1. DonaldHearnandM.PaulineBaker―ComputerGraphics‖'.PrenticeHall,Inc,1996.
2. RobertD.Cook,DavidS.Malkus,MichaelE.Plesha,RobertJ.Witt,―Conceptsand Applications ofFiniteElementAnalysis‖,4thEdition,WileyStudentEdition,2002.
3. Foley, Wan Dam, Feiner and Hughes - "Computer graphicsprinciples& practice"Pearson, 3rdedition, 2013.

COURSEOBJECTIVES
- Tounderstandthebasic knowledgeaboutkinematicsofmachines.
- Tounderstandthebasiccomponentsandlayoutoflinkagesintheassembly ofa system/machine.
- Tounderstandtheprinciplesinanalyzingtheassemblywithrespecttothe displacement, velocity, and acceleration at any point in a link of a mechanism.
- Tounderstandthemotionresultingfromaspecifiedsetoflinkages,designfew linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

COURSEOUTCOMES
Onsuccessfulcompletionofthemodulestudentswillbeable to:

- Understandthebasicknowledgeofkinematicsof machines
- Applyfundamentalsofmechanismforthedesignofnew mechanisms
- Know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- Impartknowledgeaboutthegearsandgear trains.
- Analysethemforoptimum design.

UNITI:INTRODUCTION
Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots.   **(12)**

UNITII:DIRECT&INVERSE KINEMATICS
Dot and cross products, Co-ordinate frames, Rotations, Homogeneous Coordinates, Link coordinates, D-H Representation, Arm equation -Two axis, three axis, four axis, five axis and six axisrobots. Inverse Kinematic problem, General properties of solutions, Tool configuration, Inverse Kinematics of Two axis Three axis, Four axis and Five axis robots.
(12)

UNITIII:WORKSPACEANALYSIS
Workspace analysis of Four axis, Five axis and Six axis robots, Perspective transformation, structured illumination, Camera calibration, Work envelope of Four and Five axis robots, Workspace fixtures.   **(12)**

UNITIV:DIFFERENTIALMOTIONANDSTATICS
The tool Configuration jacobian matrix for three axis and, four axis robots, joint space singularities, resolved motion ratecontrol,manipulatorjacobian forthree and fouraxis joint space singularities, induced joint torques and forces.   **(12)**

UNITV: DYNAMICANALYSISAND FORCES
Introduction, Langrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar articulated robot. Trajectory planning, Pick and place operations,Continuous path motion, Interpolated motion, Straightline motion.   **(12)**

TEXT BOOKS:
1. RobertJ.Schilling,―FundamentalsofRoboticsAnalysisandControl‖,PHI Learning, 2011.
2. NikuSB,―IntroductiontoRobotics,Analysis,Systems,Applications‖,Prentice Hall, 2001.

REFERENCEBOOKS:

1. John J Craig, ―Introduction to Robotics: Mechanics and control, Pearson, 2009,4th Ed, 2018.
2. Deb S R and Deb S, ―Robotics Technology and Flexible Automation‖, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern EconomyEdition, Prentice Hall of India P Ltd., 2006.
4. Saha S K, ―Introduction to Robotics‖, Tata McGraw Hill Education Pvt. Ltd,2010, 2nd Ed, 2014.

RAT63 PROGRAMMING FOR ROBOTICS   3   1   0   4

COURSE OBJECTIVES
➢ To acquire the knowledge on advanced algebraic tools for the description of motion.
➢ To analyze and design the motion for articulated systems
➢ To develop an ability to use software tools for analysis and design of robotic systems.

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Understand the matrix algebra and Lie algebra for computing the kinematics of robots
➢ Analyze the forward kinematics and inverse kinematics of serial and parallel robots
➢ Do the path planning for a robotic system

UNIT I: BASICS OF ROBOTICS
History – Definition – Components – Building a robot – The Robot drive mechanism. **ROBOT SIMULATION:** Mathematical modeling of the robot - Robot kinematics – Concepts of ROS and Gazebo. **(12)**

UNIT II: DESIGNING CHEFBOT HARDWARE
Specifications - Block diagram - Working with Robotic Actuators and Wheel Encoders - Interfacing DC geared motor with Tiva C LaunchPad -Interfacing quadrature encoder with Tiva C Launchpad - Working with Dynamixel actuators. **(12)**

UNIT III: WORKING WITH ROBOTIC SENSORS
Working with ultrasonic distance sensors - Working with the IR proximity sensor - Working with Inertial Measurement Unit. **(12)**

UNIT IV: PYTHON AND ROS
Introduction to OpenCV, OpenNI, and PCL - Programming Kinect with Python using ROS, OpenCV, and OpenNI - Working with Point Clouds using Kinect, ROS, OpenNI, and PCL. **(12)**

UNIT V: INTERFACING IT INTO ROS, USING PYTHON
Building ChefBot hardware - Writing a ROS Python driver for ChefBot - Understanding ChefBot ROS launch files - Working with ChefBot Python nodes and launch files - The Calibration and Testing of ChefBot - The Calibration of Xbox Kinect using ROS - Wheel odometry calibration - Testing of the robot using GUI. **(12)**

TEXT BOOKS:
1. Lentin Joseph,―Learning Robotics using Python‖, PACKT Publishing, 2015.
2. Aaron Martinez and Enrique Fernandez, ―Learning ROS for Robotics Programming‖, PACKT Publishing, 2013, 2nd Ed, 2015.

REFERENCE:
1. Bill Smart, Brian Gerkey, Morgan Quigley, ― Programming Robots with ROS: A Practical Introduction to the Robot Operating System‖, O_Reilly Publishers, 2015.

RAT64AUTOMATIONSYSTEMDESIGN   4   0   0   4

COURSEOBJECTIVES
- Toknowaboutthebasicconceptsinindustrialautomation
- Todesignautomatedsystems.
- Toknowabouttransferlinesandautomated assembly
- Beexposedtopneumatic,electric,hydraulicandelectronicsystemsinautomation of mechanical operations.
- Toknowabouttheadvancementinhydraulicsand pneumatics

COURSEOUTCOMES
- Knowledgeofindustrialautomationbytransferlinesandautomatedassemblylines. Ability to design an automated system.
- Understandingofautomatedcontrolsusingpneumaticandhydraulicsystems.
- Abilitytounderstandthe electroniccontrolsystemsinmetalmachiningandother manufacturing processes.
- Tounderstandadvancementinhydraulicsandpneumaticssystems.

UNITI:FUNDAMENTALCONCEPTSOFINDUSTRIALAUTOMATION
Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation. Selection of motor for automation system, sizing of servo motor for aspecific application, importance of sizing, selection of mechanical components, load cycle definition, load inertia and torque calculations, selection of motors.(Motion control in Automation) **(12)**

UNITII:TRANSFERLINES ANDAUTOMATEDASSEMBLY
General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automatedassembly, types ofautomatedassemblysystems,part feedingdevices,analysisof multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flowline balancing. **(12)**

UNITIII:DESIGNOFMECHATRONICSYSTEMSFORMATERIALHANDLING APPLICATIONS:
Stages in design, traditional and mechatronic design, possible design solutions. Casestudies- pick and place robot, engine management system. belt conveyor elements, selection ofbelt,drive, greasingof idlers,Plow Vs Trippers,magnetic pulley, skirt boards,trainingof belt conveyors, weighing material in motion, shuttle belt conveyor, pinion –swivel arrangement, troughing, suspended idlers, belt cleaners, transfer of material from belt tobelt, cover, safety protection at pulleys, belt speeds and widths, design of a belt conveyor, belt conveyor calculation, minimum pulley diameters, enclosures for conveyors, idler selection, conveyor belt troubles. **(12)**

UNITIV:PROGRAMMABLEAUTOMATION
Special design features of CNC systems and features for lathes and machining centers.Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.CNC architecture for intelligent machine tool – case study – CNC machine parts and working with block diagram. **(12)**

UNIT V: DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY

Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation. **(12)**

TEXT BOOKS:

1. Mikell P Groover, ―Automation Production Systems and Computer-Integrated Manufacturing‖ Pearson Education, New Delhi, 2015.
2. Bolton W, ―Mechatronics―, Pearson Education, 2011.

REFERENCE BOOKS:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications‖ , McGraw Hill , New York, USA. 2012.
2. Steve F Krar, ―Computer Numerical Control Simplified―, Industrial Press, 2001.
3. Geoffrey Boothroyd, Peter Dewhurst and Winston A. Knight, ―Product Design for manufacture and Assembly‖, CRC Press, 2011
4. Radhakrishnan, ―CAD/CAM/CIM―, Newage International Publishers, 2018.

RAT65 DESIGN OF MECHANICAL TRANSMISSION SYSTEMS   4   0   0   4

COURSE OBJECTIVES
- To introduce students to the design and theory of common machine elements and to give students experience in solving design problems involving machine elements.

COURSE OUTCOMES
Upon completion of this course, the students can able
- Formulate and analyze stresses and strains in machine elements subjected to various loads.
- Analyze and design structural joints such as Riveted joints, welded joints, Bolts.
- Analyze and design the components for power transmission like shaft and couplings.
- Analyze and design different types of gears and belts for engineering applications.
- Analyze and design mechanical springs and bearings.

UNIT I: DESIGN OF GEARS
Review of gear fundamentals, interference, gear forces, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, determining dimension of helical gear pair.

(12)

UNIT II: DESIGN OF SHAFTS AND COUPLINGS
Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and rigidity – Couplings, types and applications, design of rigid and flexible couplings – Keys, types and applications, Design of keys. **(12)**

UNIT III: BELTS AND CHAINS
Belts-Types and application, selection of flat, V-belts, and Timing belt for given power and velocity ratio. Selection of roller chain and power speed ratio, silent chain.

(12)

UNIT IV: ROLLING CONTACT BEARINGS
Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings. **(12)**

UNIT V: FRICTION DRIVES
Clutches, role of clutches, principle of operation of clutch, classification of clutches, friction materials for clutches, design of single plate and multiple plate clutches-Case studies of Conveyor Design, case study on integrated conveyor belt model formining Industry. **(12)**

TEXTBOOKS:
1. Robert L Norton, ―Machine Design-An Integrated Approach, Pearson Education, New Delhi, 2014.
2. Bandari VB, ―Design of Machine Elements, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.

REFERENCE BOOKS:
1. Shigley and Mische, ―Mechanical Engineering Design‖, McGraw Hill, Inc., New Delhi, 2008.
2. Robert L Mott, ―Machine Elements in Mechanical Design‖, Pearson/Prentice Hall, 2013.
3. Prabhu TJ, ―Design of Transmission Elements‖, Mani offset, Chennai, 2003.
4. Faculty of Mechanical Engineering, PSG College of Technology, ―Design Data Book‖, M/s DPV Printers, Coimbatore, 2010.

RAP61MODELING AND SIMULATIONLABORATORY   **0   0   3   2**

COURSEOBJECTIVES
  - ➢ To expose the students is the usage of Solid Modeling, Ansys, Adams, Delmia and CAD/CAE softwares for modeling and analysis purposes.

COURSEOUTCOMES:
  - ➢ Exposedtouse CADsoftwaresformodelingofmachinecomponents.
  - ➢ Exposedtousesoftwaresformechanismanalysis.
  - ➢ Knowledgeinconductingcrash/impactanalysisusing FEA.

LISTOFEXPERIMENTS:
  1. Solidmodelingofengineeringcomponentsand assembly.
  2. DeterminationofstressesandfactorofsafetyincriticalmachinecomponentsbyFEM and experimental validation of the results by strain measurement.
  3. Dynamicanalysisofchassisframeofanautomobile.
  4. CrashanalysisofanautomobileusingFEAsoftware.
  5. KinematicanddynamicanalysisofmechanismsusingmechanismAnsyssoftware.

REFERENCEBOOKS:
  1. WilliamTShaw,―CybersecurityforSCADAsystems‖,PennWell,2006.
  2. Stuart GMcCrady,―DesigningSCADAApplicationSoftware‖,Elsevier,2013.
  3. SIMATIC STEP 7 in the Totally Integrated Automation Portal‖, SIEMENS AG,2012.

RAP62 AUTOMATION SYSTEM DESIGN LABORATORY   0   0   3   2

COURSE OBJECTIVES

➢ To illustrate the design and simulation of multiple actuator systems usingpneumatic, electro-pneumatic and PLCs and enable the students to integrate various fringe conditions in multiple actuator systems.
➢ To design a system using PNEUMOSIM software
➢ To design a Microcontroller kit with stepper motor and drive circuit using LABVIEW software
➢ To expose the students in sensors/actuators interfaced with computers.
➢ To design a circuit using stepper motor

LIST OF EXPERIMENTS

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
6. Inspection using Machine vision System
7. Control of speed, direction and number of revolutions of a stepper motor using PC.
8. Development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors.

RAP63VIRTUALINSTRUMENTATIONLAB   0 0 3 2

COURSEOBJECTIVES
- Introduce the programming technique with instrument interfaces and applications of virtual instruments and to understand thebasics of data acquisition are introduced in Robotics and Automation systems.

COURSEOUTCOMES
- Understandtheevolution, advantages,techniques, architectureand applicationsof visual instrumentation
- Acquiringknowledge onVIprogrammingtechniques
- Studyabout thebasicsof dataacquisition
- Understandingtheconceptofcommoninstrumentinterfaceswithindustrialapplications
- Studyaboutthe use ofanalysistoolswithvarious applications

LISTOFEPERIENTS
1. CreatingVirtualInstrumentationforsimpleapplications
2. Programmingexercisesfor loopsand charts
3. Programmingexercisesforclustersandgraphs.
4. Programmingexercisesoncase andsequencestructures,file Input/Output.
5. DataacquisitionthroughVirtual Instrumentation.
6. DevelopingvoltmeterusingDAQcards.
7. DevelopingsignalgeneratorusingDAQcards.
8. SimulatingreactorcontrolusingVirtualInstrumentation.
9. Realtimetemperaturecontrol usingVirtualInstrumentation.
10. Real timesequentialcontrolofanybatchprocess.

COURSEOBJECTIVES
 ➢ Toenablethelearnertocommunicateeffectivelyandappropriately inreallife situation
 ➢ Touse Englisheffectivelyforstudypurpose acrossthe curriculum;
 ➢ TodevelopinterestinandappreciationofLiterature;
 ➢ Todevelopandintegratetheuseofthefourlanguageskillsi.e.Reading,Listening, Speaking and Writing;
 ➢ Toreviseandreinforcestructurealreadylearnt.

COURSEOUTCOMES
Attheendofthecourse Learnerswillbeable to:
 ➢ Makeeffective presentations
 ➢ Participateconfidentlyin Group Discussions.
 ➢ Attendjobinterviewsandbesuccessfulinthem.
 ➢ DevelopadequateSoft Skillsrequiredforthe workplace

UNITI:COMPOSITIONANALYSIS
TechnicalandNon-TechnicalPassages(GREBased)DifferencesinAmericanandBritish English – Analyzing Contemporary issues – Expanding Terminology.

UNITII: WRITING
JobApplicationLetterWriting–ResumeWriting

UNITIII:ORAL SKILLS
GroupDiscussion–IntroductionandPractice–TeamWork–NegotiationSkills– Organizing and Attending Meetings – Facing Interviews

UNITIV:ADAPTINGTOCORPORATELIFE
CorporateEtiquette–GroomingandDressing

UNITV:APTITUDE
Verbalandnumericalaptitude

REFERENCEBOOKS:
 1. Pushplataand Sanjay Kumar,CommunicateorCollapse: AHandbookofEffective Public Speaking, Group Discussions and Interviews, PHI Learning, Delhi, 2007.
 2. Thorpe, Edgar. Course in Mental Ability and Quantitative Aptitude. Tata McGraw-Hill, 2012.
 3. Thorpe,Edgar,TestofReasoning,TataMcGraw-Hill,2013.
 4. Prasad,H.M,HowtoprepareforGroupDiscussionandInterview,TataMcGraw- Hill, 2012.
 5. CareerPressEditors,101GreatResumes,JaicoPublishing House,2003.
 6. Aggarwal,R.S,AModernApproachtoVerbalandNon-VerbalReasoning,S.Chand& Co., 2012.

RAT71INDUSTRIAL ROBOTICS&MATERIALHANDLING   **4   0   0   4**

COURSEOBJECTIVES
- Tointroduce thebasicconcepts,partsofrobotsandtypesofrobots.
- To make the student familiar with the various drive systems for robot, sensors andtheir applications in robots and programming of robots.
- Toselectthe robotsaccordingtoits usage.
- To discuss about the various applications of robots, justification and implementation of robot.
- Toknowaboutmaterialhandlinginasystem.

COURSEOUTCOMES
TheStudentmustbeable
- Learnaboutthe basicconcepts,partsofrobotsandtypesofrobots.
- To design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming.
- Abilityin selectingtherequired robot
- Knowvariousapplicationsofrobots
- Applytheir knowledgein handlingthematerials.

UNITI:INTRODUCTION
Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, material transfer, machine loading and unloading, CNC machine tool loading, Robot centered cell.   **(12)**

UNITII:ROBOTSFORINSPECTION
Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations. **(12)**

UNITIII:OTHERAPPLICATIONS
Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications.   **(12)**

UNITIV:ENDEFFECTORS
Gripper force analysis and gripper design for typical applications, design of multipledegrees of freedom, active and passive grippers. SELECTION OF ROBOT: Factors influencingthe choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society.   **(12)**

UNITV:MATERIALHANDLING
Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), bar code technology, radio frequency identification technology. Introduction to Automation Plant design softwares.   **(12)**

TEXT BOOKS:
1. RichardDKlafter,ThomasA.chmielewskiandMichaelNegin,―Robotic Engineering – An integrated Approach‖ Prentice HallIndia, New Delhi, 2001.
2. MikellPGroover,"Automation,ProductionSystems,andComputer-IntegratedManufacturing", Pearson Education, 2015.

REFERENCES:
1. James A Rehg, ―Introduction to Robotics in CIM Systems‖, Prentice Hall of India, 2002.
2. Deb SR, "RoboticsTechnologyand Flexible Automation", Tata McGraw Hill, New Delhi, 2017.

RAT72 ARTIFICIAL INTELLIGENCE FOR ROBOTICS   4   0   0   4

COURSE OBJECTIVES
- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence.

COURSE OUTCOMES
Upon successful completion of this course student will:
- To understand the basics of Artificial Intelligence, Intelligent Agents and its structure
- To understand the problem solving by various searching techniques
- To understand the concept of informed search and Exploration
- To understand the concept of constraints satisfaction Problems and Adversarial Search
- To Understand what is Reasoning and Knowledge Representation
- To understand the concept of Reasoning with Uncertainty & Probabilistic Reasoning
- To Understand the basic forms of Machine Learning, decision trees and statistical Learning setting

UNIT I: INTRODUCTION
History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching – Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning–knowledge representation – first order logic. **(12)**

UNIT II: PLANNING
Planning with forward and backward State space search – Partial order planning – Planning graphs–Planning with propositional logic – Planning and acting in real world. **(12)**

UNIT III: REASONING
Uncertainity – Probabilistic reasoning–Filtering and prediction–Hidden Markov models– Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.**(12)**

UNIT IV: LEARNING
Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception. **(12)**

UNIT V: AI IN ROBOTICS
Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics. **(12)**

TEXT BOOKS:
1. Stuart Russell, Peter Norvig, ―Artificial Intelligence: A modern approch‖, Pearson Education, India 2009.
2. Negnevitsky, M,―ArtificialIntelligence:A guidetoIntelligentSystems‖,. Harlow: Addison-Wesley, 2011.

REFERENCEBOOKS:
1. DavidJefferis,―ArtificialIntelligence:RoboticsandMachineEvolution‖,Crabtree Publishing Company, 1999.

RAT73 TOTALLY INTEGRATED AUTOMATION   4   0   0   4

COURSE OBJECTIVES
- To gain knowledge in automation in industries.
- To gain knowledge in various electrical and electronic programmable automations and their applications.
- To know about the basic in SCADA and DCS systems.
- To gain knowledge in communication protocols in an integrated system
- To know about the advanced in automation industries

COURSE OUTCOMES
- Knowledge of PLC & PAC automation
- Ability to apply SCADA and usage of C programming for report generation
- Acquiring information's on communication protocols in automation systems
- Ability to design and develop automatic control system using distributed control systems.
- Knowledge in automation of industries.

UNIT I: TOTALLY INTEGRATED AUTOMATION
Need for TIA - TIA Architecture - Components of TIA systems - Selection of TIA Components – Programmable Automation Controllers (PAC) - Vertical Integration structure. **(12)**

UNIT II: SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)
Overview – Developer and runtime packages – Architecture – Tools – Tags – Graphics - Alarm logging – Tag logging – Trends – History – Report generation, VB & C Scripts for SCADA application. **(12)**

UNIT III: COMMUNICATION PROTOCOLS OF SCADA
Proprietary and open Protocols – OLE/OPC – DDE – Server/Client Configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive, and other field device. **(12)**

UNIT IV: DISTRIBUTED CONTROL SYSTEMS (DCS):
DCS– architecture –local control unit- programming language –communication facilities – operator interface–engineering interfaces. **(12)**

UNIT V: INDUSTRIAL PLANT DESIGN
Design criteria – Process sequencing - Plant layout modeling – Selection of industrial power and automation cables, Overview of plant simulation software. Case Studies: Case studies of Machine automation, Process automation. **(12)**

TEXT BOOKS:
1. David Bailey, Edwin Wright, ―Practical SCADA for industry, Newnes, Burlington, 2003.
2. Gordon Clarke, Deon Reynders, Edwin Wright, ―Practical Modern SCADA Protocols: DNP3, 60870.5 and Related systems‖, Newnes Publishing, 2004.

RAP71 TOTALLY INTEGRATED AUTOMATION LABORATORY 0 0 3 2

COURSE OBJECTIVES
- To develop student's skills in perform kinematics analysis of robot systems
- To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
- To provide the student with some knowledge and analysis skills associated with trajectory planning.
- To provide the student with some knowledge and skills associated with robot control.

COURSE OUTCOMES
After the successful completion of this course, the student will be able to:
- Select & identify suitable automation hardware for the given application.
- Describe & explain potential areas of automation.
- Differentiate various control aspects of automation.
- Demonstrate the self learning capability of Industrial Automation.

LIST OF EPERIMENTS:
1. Design of conveyor automation system using PLC, SCADA and Electrical drive.
2. Design of inspection automation system using sensors, PLC, HMI/SCADA.
3. Sizing and Selection of industrial power and automation cable for a typical application.
4. Design of simple water management system using PLC, SCADA and Electrical drive.
5. Design of simple power system automation.
6. Design and Simulation of process automation using CIROS.
7. Simulation of robotic system using CIROS.

RAP72 INNOVATIVE PRACTICES   **0   0   3   2**

Students have to do design a Mechatronic product based on the given topic. It includes modeling, simulation, and design of a particular product

RAP73INDUSTRIALVISIT/TRAINING   0   0   2   1

The students are required to undergo in plant training for a period of two weeks /four industrial visits during the summer vacation after the fourth semester. Each student has to submit a detailed report on the training programme undergone. Each student will be evaluated by an internal assessment committee (comprising of the Head of the Department and two faculty members) for a total of 50marks

RAPW7PROJECT WORK-I   **0   0   6   4**

COURSEOBJECTIVES

➢ To develop the abilityto solve a specific problem right from its identification and literature review till the successful solution of the same.

➢ To train the students in preparing project reports and to face reviews and vivavoce examination.

COURSEOUTCOMES

➢ On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

Each batch of 2 or 3 students will be assigned an experimental or a theoretical project to be carriedout underthe supervision ofa guide. The project workhas tobe carried out in the 7th and 8th semesters and has to be completed by the end of the 8th semester. In the phase I ofthe project work, the progress of the work carried out in the 7th semester will be monitored and assessed internally for a total of 50 marks. A committee of departmental faculty members comprising the project guide, the Head of the Department and one more faculty member will conduct the internal assessment.

RAT81PROFESSIONAL ETHICS   2   0   0   1

COURSEOBJECTIVES

➤ To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moraland Social Valuesand Loyaltyand to appreciate the rights of others.

CORSEOUTCOMES
➤ Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

The course shouldcoveredthefollowingtopicsbywayofSeminars,Expert Lecturesand

ASSIGNMENTS
Engineering Ethics– Moral issues, Ethical theories and their uses Engineering as Experimentation–Code of Ethics Engineer's responsibilityfor safetyResponsibilities and rights Global issues of engineering ethics

REFERENCEBOOKS
1. MikeMartin and Roland Schinzinger, ―Ethics in Engineeringǁ, Tata McGraw-Hill, 2003

RAT82 MAINTENANCE AND SAFETY ENGINEERING   4   0   0   4

COURSE OBJECTIVES
- ➢ To impart knowledge in maintenance
- ➢ To know about the fundamentals of maintenance and to implement it.
- ➢ To study about safety engineering practices.
- ➢ To analyze the hazards in protection.
- ➢ To know about the safety in machine operation.

COURSE OUTCOMES
- ➢ Maintain the industry without any risk in its operation Improve the production
- ➢ Analyze the hazards in maintenance and to solve it.
- ➢ Identify and prevent chemical, environmental mechanical, fire hazard through analysis
- ➢ Apply proper safety techniques on safety engineering and management

UNIT I: MAINTENANCE
Types – breakdown, preventive, predictive, TPM; elements of preventive maintenance – checklist, schedule, procedure. **(12)**

UNIT II: TOTAL PRODUCTIVE MAINTENANCE
Principles; preparatory stages of implementation – TPM organisation structure, creation; basic TPM policies and aids, master plan. TPM IMPLEMENTATION: Small group activities, autonomous maintenance, establishing planned maintenance, training, developing equipment management program. **(12)**

UNIT III: SAFETY SYSTEMS ANALYSIS
Definitions, safety systems; safety information system: basic concept, safety cost / benefit analysis; industrial safety engineering, OSHA regulations. **(12)**

UNIT IV: HAZARD ANALYSIS
General hazard analysis: electrical, physical and chemical hazard, detailed hazard analysis. Cost effectiveness in hazard elimination. Logical analysis: map method, tabular method, fault tree analysis and hazop studies. Fire Protection System: Chemistry of fire, water sprinkler, fire hydrant, alarm and detection system. Suppression system: CO_2 system, foam system, Dry Chemical Powder (DCP) system, halon system, portable extinguisher.
(12)

UNIT V: SAFETY IN MACHINE OPERATION
Design for safety, lock out system, work permit system, safety in use of power press, cranes. Safety in foundry, forging, welding, hot working and cold working, electroplating and boiler operation. SAFETY AND LAW: Provisions in factory act for safety, explosive act, workmen compensation act, compensation calculation. Boiler act and pollution control act.
(12)

TEXT BOOKS:
1. John Ridley, ―Safety at Work‖, Butter Worth Publisher, Oxford, 1997.
2. Robinson CJ and Ginder AP, ―Implementing TPM‖, Productivity Press, USA, 1995.

REFERENCEBOOKS:
1. DhillonBS,—Maintainability,MaintenanceandReliabilityforEngineers‖,CRC Press, 2006.
2. Heinrich H W, —Industrial Accident Prevention‖, National SafetyCouncil, Chicago, 1998.
3. NationalSafetyCouncil,—PersonalProtectiveEquipment‖,Bombay,1998.
4. NationalSafety Council,—AccidentPreventionManualforIndustrialOperations‖, Chicago, 1995.
5. PatrickAMichaud,—AccidentPreventionandOSHACompliance‖,CRCPress, 1995.
6. DerekJames,—FirePreventionHandbook‖,ButterWorth&Co.,Oxford,1991.
7. Dan Peterson, —Techniquesof SafetyManagement‖, 1990.

RAPW8PROJECTWORK-II   0   0   9   8

COURSEOBJECTIVES

➢ To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSEOUTCOMES

➢ On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

Extension and completion of project work started in the previous semester. On completion of the project work, each student has to prepare a project report and submit the same to the department. In the Phase II, the project work and the report will be evaluatedby the internal assessment committee by conducting two reviews and one demo for a total of 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the university.

RAE01-VLSIDESIGN   4   0   0   4

COURSEOBJECTIVES
- ➢ TointroduceDigitalVLSIdesignconceptsandtointroduceICdesigningusingField Programmable Gate Arrays.
- ➢ ToimpartskillsetinVHDLHardwareDescriptionLanguageandunderstandreal time modeling of ICs with test benches.

COURSEOUTCOMES
- ➢ FoundationalskillsetinCMOStechnologyandlogicimplementationusingCMOS.
- ➢ BasicsofVHDLhardware descriptionlanguageandVHDLlevelsofabstraction.
- ➢ Workingknowledgeof VHDLprogrammingusingconcurrent architecture
- ➢ Designingcomplexdigitalsystemsusingcomponentinstantiation.
- ➢ Workingknowledge of testbench development.

UNITI:CMOSTECHNOLOGY
Introduction to MOS transistors and VLSI fabrication(NMOS, PMOS, CMOS and BiCMOS)- Introduction to power reduction techniques-Dynamic Power Reduction-Static Power Reduction- NMOS and CMOS inverter- Determination of pull up to pull down ratios – propagation delays – powerdissipation Stick Diagram -MOS layers - Design rules and layout- choice of layers and Scaling.   **(12)**

UNITII:COMBINATIONALANDSEQUENTIALCIRCUITDESIGN
Pass transistor and transmission gates-Inverter-NAND gates and NOR Gates for n MOS, CMOS and Bi CMOS – parity generator – Multiplexers- code converters – Programmable Logic Devices (nMOS PLA and CMOS PLA) – Clocked sequential circuits – D-Latch and D- Flip-Flop–Memories(DRAMcell,SRAMCellandPseudoStaticRAMcell) –Inverting and Non-Inverting Registers – Barrel Shifter.   **(12)**

UNITIII:SUBSYSTEMDESIGN
 Circuit Families – Dynamic CMOS logic, Domino CMOS logic and Pseudo NMOS logic-One bit adder- multi bit adder –Ripple carry- Carry Skip Adder-Carry Look Ahead Adder-Design of signed parallel adder-comparison of different schemes in terms of delay – Multipliers – Design of serial and parallel multipliers- Different schemes and their comparison. 2_s complement array multiplication-Booth encoding.   **(12)**

UNITIV:CMOSTESTING
Need for testing- Test Procedure, Design for Testability – Ad Hoc Testing – Scan-Based Test-Boundary-Scan Design – Built-in-Self-Test(BIST)- Test- Pattern Generation – Fault Models – Automatic Test Pattern Generation – Fault Simulation.   **(12)**

UNITV:INTRODUCTIONTOVERILOG:
Basics of Verilog, operators, Data Types, Continuous assignments, Sequential and parallel statement groups. Timingcontrol (level andedge sensitive) and delays, tasks and functions, control statements, Blocking &non blocking assignments, If-else and case statements, For-while-repeat and forever loops, Rise, fall, min, max delays, Behavioural and synthesizable coding styles for modelling combinational logic, Behavioural& synthesizable coding styles

formodellingsequential logic. **(12)**

TEXT BOOKS:
1. Neil H.E. Weste and K.Eshraghian, ―Principles of CMOS VLSI design,‖ Addison Wesley Publishing Company, old edition publication 2010.
2. Neil He Weste,David Harris and Ayan Banerjee, ―CMOS VLSI design-A circuits andSystems Perspective, Dorling Kindersley (india) Pvt Ltd, 2009.
3. JanM.Rabaey,AnanthaChandrakasanandBorivojeNikolic,―DigitalIntegrated Circuits – A Design Perspective,‖ Prentice Hall of India, 2012.
4. J.Bhasker ―AVerilogHDLPrimer,‖StarGalaxyPress,old edition, 2004.
5. Wayne wolf, ―Modern VLSI Design: System on Chip Design,‖ Prentice Hall of India,2012.

REFERENCEBOOKS:
1. E.D.Fabricious,―IntroductiontoVLSIdesign‖,McGrawHill,2005.
2. Thomas, D .E .,Philip.R. Moorby ―The Verilog Hardware Description Language‖,2nd ed.,Kluwer Academic Publishers,2002.
3. SebastianSmith, ―Application Specific Integrated Circuits‖, Pearson Education,2001.
4. DebaPrasadDas,―VLSIDesign‖,OxfordUniversityPress,2012.

RAE02SOFTCOMPUTING   **4   0   0   4**

COURSEOBJECTIVES
 ➢ Toexpose thestudentstothe conceptsoffeedforwardneuralnetworks.
 ➢ Toprovideadequateknowledgeaboutfeedbackneural networks
 ➢ Toprovide adequate knowledge aboutfuzzyandneuro-fuzzysystems
 ➢ Toprovidecomprehensiveknowledgeoffuzzylogiccontroltorealtimesystems.
 ➢ To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

COURSEOUTCOMES
 ➢ The studentswillbeable tounderstandneural network, fuzzylogic and itsapplication and neuro fuzzy controller.

UNITI:ARTIFICIALNEURALNETWORK
Review of fundamentals – Biological neuron, Artificial neuron, activation function, Single layer perceptron- limitation – Multilayer perceptron- Back propagation algorithm –Recurrent Network adaptive resonance theory based network – Radial base function network- Online learning algorithms, BP through time- RTRL algorithm reinforce learning.   **(12)**

UNITII:NEURALNETWORKSFORMODELINGANDCONTROL
Modeling of non-linear systems using ANN- Generation of training data – Optimal architecture –Model validation – Control of non- linear systems using ANN – Direct and Indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox.   **(12)**

UNITIII:FUZZYSET THEORY
Fuzzysettheory-Fuzzysets-Operationonfuzzysets-Scalarcardinality, Fuzzycardinality, union and intersection- complement (Yeger and sugeno), equilibrium points, aggregation, projection,composition, cylindrical extension, fuzzy relation- fuzzy membership functions.
                                                                             (12)
UNITIV:FUZZYLOGICFORMODELINGAND CONTROL
Modelingof non linear systems usingfuzzymodels – TSKmodel – Fuzzylogic controller fuzzification–knowledgebase-Decisionmakinglogic   –Defuzzification–Adaptivefuzzy systems – Familiarization with fuzzy logic toolbox.   **(12)**

UNITV:HYBRIDCONTROLSCHEMES
Fuzzification and rule base using ANN – Neuro fuzzy systems ANFIS – Fuzzy neuron – Introduction to GA – Optimization of membership function and rule base using Genetic algorithm–Introductiontosupportvectormachine–particleswarmoptimization–case studyfamiliarization with ANFIS toolbox.   **(12)**

TEXT BOOKS:
 1. LaureneV.Fausett,―FundamentalsofNeuralNetworks,Architecture,Algorithms, and Applications‖, Pearson Education, 2008.
 2. TimothyJ.Ross,―FuzzyLogicwithEngineeringApplications‖,Wiley,ThirdEdition, 2010.

3. DavidE.Goldberg,―GeneticAlgorithmsinSearch,Optimization,andMachineLearning‖, Pearson Education, 2009

REFERENCEBOOKS:
1. GeorgeJ.KlirandBoYuan,―FuzzySetsandFuzzyLogic:TheoryandApplications‖, Prentice HalI, First Edition, old edition,2007.
2. W.T.Miller,R.S.SuttonandP.J.Webrose,―NeuralNetworksforControl‖,MITPress, 2008.
3. C.CortesandV.Vapnik,"Support-VectorNetworks,MachineLearning‖,oldedition,2018.

RAE03 INDUSTRIAL NETWORKING   4 0 0 4

COURSE OBJECTIVES

➢ Basic knowledge about networking in industries.
➢ Understand the evolution of computer networks using the layered network architecture.
➢ Understand the concepts of data communications.
➢ Be familiar with the Transmission media and Tools.
➢ Design computer networks using sub-netting and routing concepts.

COURSE OUTCOMES

At the end of the course, the student should be able to:
➢ Apply the concepts of data communications and to design computer networks using subnetting and routing concepts.
➢ Compare the various medium access control techniques.
➢ Compare and contrast the characteristics of physical layer.
➢ Analyze the different protocols.
➢ Compare and contrast the different network components.

UNIT I: INTRODUCTION
Modern instrumentation and control systems – Terminology – Topology – Mechanisms - Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 interface standard – EIA-485 interface standard – Current loop and EIA-485 converters - Fibre optic cable components and parameters – Basic cable types – Connection fibers – Troubleshooting.   **(12)**

UNIT II: COMMUNICATION BUS PROTOCOLS
Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway –AS interface (AS-i)-DeviceNet: Physical layer – Topology – Device taps –Profibus PA/DP/FMS: Protocol stack – System operation.CAN BUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – Detection – processing – Introduction to CAN 2.0B. **(12)**

UNIT III: ETHERNET SYSTEMS
IEEE 802.3 – Physical layer - Medium access control – Collisions - Ethernet design rules - Fast and gigbit Ethernet systems - design considerations - Internet layer protocol - UDP - TCP/IP - ProfiNet - LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet.   **(12)**

UNIT IV: WIRELESS COMMUNICATIONS
Radio spectrum – Frequency allocation – Radio modem – Intermodulation – Implementing a radio link – RFID: Basic principles of radio frequency identification – Transponders – Interrogators, WirelessHART.   **(12)**

UNIT V: APPLICATIONS

Automotive communication technologies – Design of automotive X-by-Wire systems, - The LIN standard – The IEC/IEEE Train communication network: Applyingtrain communication network for data communications in electrical substations. **(12)**

TEXT BOOKS:
1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, ―Practical IndustrialData Networks: Design, Installation and Troubleshooting, Newnes (Elsevier), 2004.
2. DominiqueParet,―MultiplexedNetworksforEmbeddedSystems,JohnWiley& Sons, 2007.

REFERENCEBOOKS:
1. Richard Zurawski, ―The Industrial Communication Technology Handbook‖, Taylor and Francis, 2005.
2. DeonReyndersandEdwinWright,―PracticalTCP/IPandEthernetNetworking, IDC Technologies, 2006.
3. James Powell, HenryVandelinde, ―Catching the Process Fieldbus an Introduction to PROFIBUS for Process Automation", Momentum Press, 2013.
4. AlbertLozano-Nieto,―RFIDDesign FundamentalsandApplications‖,CRCPress, 2011.

RAE04 FIELD AND SERVICES ROBOTICS   4   0   0   4

COURSE OBJECTIVES
- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study about the localization, planning and navigation.
- To study the control of robots for some specific applications.
- To study about the humanoid robots.

COURSE OUTCOMES
Upon completion of the course, the student should be able to:
- Explain the basic concepts of working of robot.
- Analyze the function of sensors in the robot.
- Developing programs to use a robot for a typical application.
- Use Robots in different applications.
- Know about the humanoid robots functions & its operations.

UNIT I: INTRODUCTION
History of service robotics – Present status and future trends – Need for service robots - Applications- Examples and Specifications of service and field Robots. Non conventional Industrial robots. **(12)**

UNIT II: LOCALIZATION
Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization- Monte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization. **(12)**

UNIT III: PLANNING AND NAVIGATION
Introduction-Path planning overview- Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance - Case studies: Tiered robot architectures. **(12)**

UNIT IV: FIELD ROBOTS
Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, Civilian and military applications, Nuclear applications, Space applications. **(12)**

UNIT V: HUMANOIDS
Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications_Case studies. **(12)**

TEXT BOOKS:
1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, „Introduction to Autonomous Mobile Robots‖, Bradford Company Scituate, USA, 2004

2. Riadh Siaer, „The future of Humanoid Robots- Research and applications", Intech Publications, 2012.

REFERENCEBOOKS:
1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011

RAE05PCBASEDINDUSTRIALAUTOMATION   4   0   0   4

COURSEOBJECTIVES

Tostudythe TC3 functionsandtypesofconnectivityusedinIndustrial automation.

COURSEOUTCOMES

Afterthesuccessfulcompletionofthiscourse,thestudentwillbeableto:
- StudyTwinCATIntroduction&Licensing.
- ApplyTC3 functionsinMatlab/LabVIEW/Simulink
- Learnthevarioustypesof connectivityused in Automation
- Implementthetechniquesinhardwareplatform.

UNITI:INTRODUCTION

PC based Automation: TwinCAT Introduction & Licensing - TC3 Workbench - Source Control - Project compare tool - System I/O Variable - ADS Setting-Global Data types - EtherCAT - Hardware Configuration - EPC & IPC Introduction to Basic Components - Editors - Library Management - Visualization - Programming References - Library Creation.

(12)

UNITII:TC3 FUNCTIONS

Measurement Control-Motion - Motion Axis Configuration - NC PTP - NCI - TwinCAT Kinematic transformation-Stepper Motor & Drive terminal Configuration - C/C++ - Matlab/LabVIEW/Simulink - I/O - Safety PLC.   **(12)**

UNITIII:CONNECTIVITY

Serial Communication - RS232, RS485/RS422, MODBUS RTU, CANOpen, ProfiBus, DeviceNet - Database Server - SMS/SMTP - TCP/IP.   **(12)**

UNITIV:BUILDINGAUTOMATION

Introduction - Hardware Requirements - BA PLC Libraries - HVAC - BACnet IP - EIB - TwinCAT Diagnostics.   **(12)**

UNITV:LAB SESSION
1. TwinCATSoftwareand Hardware
2. NCPTPProgramming
3. MotionControlprogrammingwithkinematictransformation
4. Communication programming
5. Buildingautomationsystemintegration   **(12)**
6.

TEXT BOOKS:
1. A.D.Rodic,Automation&Control-Theory&Practice,In-Techpublications,2009.
2. Frank Lamb,IndustrialAutomation,Handsonpractice,McGrawHill,2018. 3.

REFERENCE:

https://infosys.beckhoff.com

RAE06 IMAGE PROCESSING AND VISION SYSTEMS   4   0   0   4

COURSE OBJECTIVES
- To represent and interpret image in its numeric and graphical form.
- To understand geometric relationship of pixels.
- To write simple codes for improving image quality.
- To extract useful information from image contents through processing.
- To understand and document needs for specific machine vision system.
- To develop machine vision system based on requirement.

COURSE OUTCOMES
After successful completion of the course, student will be able to
- Represent and interpret image in its numeric and graphical form.
- Understand geometric relationship of pixels.
- Write simple codes for improving image quality.
- Extract useful information from image contents through processing.
- Understand and document needs for specific machine vision system.
- Develop machine vision system based on requirement.

UNIT I: VISION SYSTEM
Basic Components - Elements of visual perception: structure of human eye, Image formation in the eye – pinhole cameras - color cameras – Image formation model –Imaging components and illumination techniques - Picture coding – Basic relationship between pixels - Camera-Computer interfaces.   **(12)**

UNIT II: LOW-LEVEL VISION:
Image representation – Gray level transformations, Histogram equalization, Image subtraction, Image averaging – Filters: Smoothing spatial filters, sharpening spatial filters, smoothing frequency domain filters, sharpening frequency domain filters -Edge detection.
                                                                                (12)

UNIT III: HIGHER-LEVEL VISION:
Segmentation: Edge linking and Boundary Detection, Thresholding, Region-oriented segmentation, the use of motion – Description: Boundary Descriptors, Regional Descriptors, Recognition: Decision-Theoretic methods, structural methods.   **(12)**

UNIT IV: APPLICATIONS:
Camera Calibration - Stereo Imaging - Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements -Vision and Tracking: Following the road, Iconic Image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering, Kalman Filtering.   **(12)**

UNIT V: ROBOT VISION
Basic introduction to Robotic operating System (ROS) - Installing and testing ROS camera Drivers, ROS to OpenCV -The cvbridge Package. Introduction to OpenCV image processing library and MATLAB programming.   **(12)**

TEXTBOOKS:
1. K.S.Fu,R.C.Gonzalez,CSG.Lee,―Roboticscontrol,sensing,visionandIntelligence‖, McGraw Hill Education Pvt. Ltd., 2013.
2. RichardDKlafter,ThomasAChmielewski,MichaelNegin,―RoboticsEngineering:An Integrated Approach‖, PHI Learning, New Delhi, 2009.

REFERENCEBOOKS:
1. DamianMLyons,―ClusterComputingforRoboticsandComputerVision‖,World Scientific, Singapore, 2011.
2. RafelC.Gonzalez,RichardE.Woods,StevenL.Eddins,‖DigitalImageProcessing using MATLAB‖,2nd edition, Tata McGraw Hill, 2010.
3. CarstenSteger, Markus Ulrich, ChristianWiedemann, ―MachineVision Algorithmsand Applications‖, WILEY-VCH, Weinheim, 2008.
4. KennethDawson-Howe,―APracticalIntroduction toComputerVisionwithOpenCV‖, Wiley, Singapore, 2014.

RAE07FPGABASEDSYSTEM DESIGN   **4   0   0   4**

COURSEOBJECTIVES
➢ TolearnthealgorithmsandmodelsdevelopedinMATLAB, simulinkintoVHDLfor implementing in PLD and also realize the concept of interfacing

COURSEOUTCOMES
➢ Acquireknowledgeaboutprogrammablelogicdevices.
➢ Extrapolatevariousprogramminglanguagestodevelopdigitaldesignsfor implementation in either a processor or in PLD.
➢ GeneralizewithVHDLtosimulateandsynthesizethedigitaldesign.
➢ Implementcombinationallogic,sequentiallogicusingVHDLandacquire knowledge about state machine design, memories.
➢ TranslatealgorithmsandmodelsdevelopedinMATLAB,simulinkintoVHDLfor implementing in PLD and also realize the concept of interfacing.

UNITI:INTRODUCTIONTOPROGRAMMABLELOGIC DEVICES
Introduction to the programmable logic devices, comparison of programmable logic with digital logic and processors - Types of programmable logic, Simple Programmable Logic Device (SPLD), Complex Programmable Logic Device (CPLD), Field Programmable Gate Array (FPGA)- PLD configuration technologies- Programmable logic design methods and tools, Technology trends.   **(12)**

UNITII:DESIGNLANGUAGES
Introduction to various software programming languages: C, C++, Java, Visual basics, scripting language, PHP- Hardware description language, VHDL description for two input and gate- Hardware description language, Verilog HDLdescription for full adder- Hardware description language, Verilog description for voltage amplifier- Introduction to mathematical modeling tools, modeling of motor control system using simulink.   **(12)**

UNITIII:DIGITALLOGICDESIGNWITHVHDL
Designingwithhighdefinitionlanguage-Designentrymethods-Logicsynthesis-Entities, architectures, packages and configurations- Coding styles for VHDL.   **(12)**

UNITIV:COMBINATIONALANDSEQUENTIALLOGICDESIGN
Introduction to combinational logic design, VHDL design for adders and four to one multiplexer- Encoder design using VHDL- Introduction to sequential logic design andVHDL design for D-latch- Design of binary counter using VHDL- Introduction to state machine design, design of sequence detector using VHDL- VHDL design of memories: RAM, ROM- Testing of VHDL design.   **(12)**

UNITV:SYSTEMLEVELDESIGN
Creating VHDL test bench for digital to analog converter- Creating VHDL test bench for thyristor gate control pulse-generator- Electronic system level design- Creating VHDL test bench for digital filter design.   **(12)**

TEXT BOOKS

1. IanGrout,―DigitalSystemDesignwithFPGAandCPLD‖,Newnespublishers,2nd edition, 2008.

REFERENCEBOOKS

1. PeterWilson,―DesignRecipesforFPGAs‖,Newnespublishers,3rdedition,2007.
2. WayneWolf,―FPGABasedSystemDesign‖,PrenticeHall,1stedition,2004.

COURSEOBJECTIVES
AnalysisandapplicationofloadcontroltechniquesinIndustries.

COURSEOUTCOMES
> Acquire knowledge about load control techniques in industries and its application.. Acquire knowledge about load management to reduce demand of electricity during peak time.
> Analyseandunderstanddifferentenergysavingopportunitiesinindustries.
> Acquire knowledge about reactive power control in industries and analyse different power factor improvement methods.
> Learn mathematical modelling and profiling of various loads such as cool storage, cooling and heating loads.
>

UNITI:INTRODUCTION
Construction and Principle of operation of PMSM and SynRM – AC drive Hardware Blocks– Control Blocks – Automatic Motor Adaptation – Parameterization of Drives (Local and Remote).   **(12)**

UNITII:CONFIGURATIONSOFDIFFERENTI/OCONTROL
Digital Input and output – Analog Input and output Control-word access – Motion control - Sequential Logic Control (SLC) - Parameterization for different communication protocol:RS 485 – MODBUS - PROFIBUS.   **(12)**

UNITIII:CONFIGURATIONFORDIFFERENT APPLICATIONS
 AQUA–HVAC–Automation –Master/Slavecontrol.   **(12)**

UNITIV:PRACTICAL
Performance characterization of PMSM and SynRM - Conveyor control – Cascaded Pump Control – Synchronization of Drives with Master Slave Control.   **(12)**

TEXT BOOKS:
2. VedamSubramaiyan,ElectricDrives,TataMcGrawHill,2011.
REFERENCES:
1. ProgrammingGuideforFCDrivesbyDanfoss Industriespvt.Ltd.
2. Monograph preparedbyPSG-DanfossCoEfor ClimateandEnergy.

RAE09APPLIEDROBOTICS **4 0 0 4**

COURSEOBJECTIVES
> Thiscourseattemptstoaddresstheapplicationsofrobotsinsomespecificareas where the use of robots have significantly improved productivity

COURSEOUTCOMES
Attheendofthe course,studentwillbeable to
> UnderstandthevarioustypesofIndustrial,fieldandserviceRobotsandtheir characteristics and capabilities.
> EquipwiththeknowledgeofMathematicalmodelingofspecialized Robots.
> FamiliarizewiththeoperationofRobotsandprocessesinvolved.
> SelecttherightRobotwithrequiredconfigurationsandspecificationsfor applications.
> Familiarizewiththeapplicationsofvariousfieldandservice Robots.

UNITI: APPLICATIONSOFROBOTSININDUSTRIES
Introduction to robotics - overview, A short history of industrial Robots - Applications of Robots in Welding, car body assembly, painting- Applications of Robot in Machining, material transfer- Kinematics and mechanisms review, tasks descriptions, teaching and programming- End-effectors and system integration.   **(12)**

UNITII:COOPERATIVEANDSWARMROBOTS
Cooperative manipulation, Challenges in cooperative manipulation- Case studies for Cooperative manipulation for Industrial and Service applications- Introduction to swarm Robots, comparison with other multi-agent systems, challenges and benefits of swarm systems- Algorithms for swarm Robots, application, case study of swarm Robots. **(12)**

UNITIII:FIELDROBOTICS
Forestry, Robot locomotion, forestry automation, SLAM in forestry- autonomous Robots for silviculture andtreatment- Broad acre Applications: Automatic guidance, sowing, weeding, sprayingandbroad-acreharvesting,Horticulture:pickingoffruits-Robotmilking,sheep shearing,slaughtering,livestockinspection-Robotsinconstruction,unsolvedproblemsin construction,Futuredirections-Robotsforhazardousapplications,enablingtechnologies- Search and Rescue robotics: Disaster characteristics-Impact on Robots, Robots actually used at disaster, promising robots, open issues – case studies.   **(12)**

UNITIV:ROBOTSIN SURGERYANDREHABILITATION
Medical robotics, Core concepts, Technology- Medical robotic systems, Research areas and applications- Rehabilitation and Health care robotics: Overview, physical therapy andtrainingRobots-Aidsforpeoplewithdisabilities-Smartprosthesesandorthoses, diagnosis and monitoring.   **(12)**

UNITV:ENTERTAINMENTANDPERSONALROBOTICS
CleaningRobots,lawnmovingRobots-Smartappliancesandsmarthomes-Theroleof Robots in education, Educational robotic platforms-. Robots and informal learning venues
          (12)

TEXT BOOKS
1. BrunoSiciliano,OussamaKhatib,―SpringerHandbookofRobotics‖,Springer-Verlag Berlin Heidelberg 2008.
2. YangshengXuHuihuanQianXinyuWu,"HouseholdandServiceRobots",Elsevier Ltd, 2015.

REFERENCEBOOKS
1. AleksandarLazinica,―MobileRobotsTowardsNewApplications‖,AdvancedRobotic Systems International, 2006.
2. GregoryDudek,MichaelJenkin,―ComputationalPrinciplesofMobileRobotics‖,2nd edition, Oxford University Press, 2010.
3. LMarques,AdeAlmeida,MoTokhi,GSVirk,―AdvancesinMobileRobotics‖,World Scientific Publishing Co. Pte. Ltd. 2008.

RAE10 WIRELESS SENSOR NETWORKS FOR ROBOTICS   4   0   0   4

COURSE OBJECTIVES
- ➢ To know the basic knowledge about wireless sensor networks
- ➢ To impart knowledge in networking using sensors
- ➢ To know about the tools used in networking
- ➢ To understand the basic in wireless architecture
- ➢ To know about the different techniques used in networking

COURSE OUTCOMES:
- ➢ Ability to know about the different techniques used in networking
- ➢ To expose basic knowledge about wireless sensor networks
- ➢ Ability to know about the tools in networking
- ➢ Understand the basic in wireless architecture
- ➢ Ability to know about the protocols used in networking

UNIT I: OVERVIEW OF WIRELESS SENSOR NETWORKS
Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks. **(12)**

UNIT II: ARCHITECTURE
Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. **(12)**

UNIT III: NETWORKING SENSORS
Physical Layer and Transreceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.**(12)**

UNIT IV: INFRASTRUCTURE ESTABLISHMENT
Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. **(12)**

UNIT V: SENSOR NETWORK PLATFORMS AND TOOLS
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming. **(12)**

TEXT BOOKS
1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, ―Wireless Sensor Networks-An Information Processing Approach", Elsevier, 2007.

REFERENCE BOOKS
1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, ―Wireless Sensor Networks- Technology, Protocols, And Applications‖, John Wiley, 2007.
2. Anna Hac, ―Wireless Sensor Network Designs‖, John Wiley, 2003.

RAE11INTERNETTOOLSANDJAVA PROGRAMMING   **4   0   0   4**

COURSEOBJECTIVES
- Tolearnabout the varioustoolsusedin internet.
- To learnJavaProgramming.
- TounderstanddifferentInternetTechnologiesandthewaytohandle it.
- Tobe familiarwithclient–side programmingandserver–side programming.
- Tolearnto develop web basedapplications.

COURSEOUTCOMES
Atthe endofthe course,the studentshouldbe ableto:
- ImplementJavaprogramsandtocreateabasicwebsiteusingHTMLandCascading Style Sheets.
- DesignandimplementdynamicwebpagewithvalidationusingJavaScriptobjects and by applying different event handling mechanisms.
- DesignrichclientpresentationusingAJAX.
- Designandimplementsimple webpageinPHP,andtopresentdatainXMLformat.
- DesignandimplementserversideprogramsusingServletsandJSP.

UNITI:INTERNETSERVICESAND PROTOCOLS
Fundamentals-InternetAddresses -FileTransferProtocol(FTP)–HTTP– HTTPS-SMTP- DNS - Net Telephony – Internet RelayChat - Newsgroups - Remote Login - Telnet - Socket programming, UDP, TCP.   **(12)**

UNITII:OBJECTORIENTATIONINJAVA
Introduction -DataTypes-Operators-Declarations -Control Structures- Arraysand Strings - Input/Ouput. Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword - object based Vs oriented programming.- -Inheritance-Reusability - Composing class - Abstract classes - Abstract Functions – Method Overloading and Method Overriding- Wrapper Classes.   **(12)**

UNITIII:PACKAGESANDINTERFACES
Packages-Accessprotection -Importingpackages-Interface -DefiningandImplementing Interface - Applying Interface - Variables in Interfaces.   **(12)**

UNITIV:EXCEPTIONHANDLING
Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiplecatch clauses - Nested try statements - Throw - Throws - Java Built-in Exception - Creating your own subclasses.   **(12)**

UNITV:MULTITHREADEDPROGRAMMING
Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface- Mainthread- CreatingtheThread- Synchronization-InterthreadCommunication - Deadlock. I/O, APPLETS: I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input - Applet fundamentals - Native methods - GUI Components - Applets - Java Scripts – AWT / Swings. JAVA DATABASE PROGRAMMING: JDBC – Database Connection and Table Creation.   **(12)**

TEXT BOOKS:
1. PatrickNaughtonandHerbertSchildt,"JAVA -TheCompleteReference",Tata McGraw Hill, old edition, 2010.
2. JamesKL,‖The Internet:AUsersGuide‖,Prentice Hall ofIndia,NewDelhi,2003.

REFERENCEBOOKS:
1. DeitelandDeitel,"JAVA-HowtoProgram", PrenticeHallInternationalInc, 2003.
2. WilliamStanekandPeterNorton,"PeterNorton'sGuidetoJavaProgramming",Tech Media Publications, old edition, 1997.
3. MarkGrand,"JAVALanguageReference",O'Reilly&AssociatesInc.,oldedition, 2018, Jan13th .
4. HorstmannandCornell,CoreJava‖,PearsonEducation,2001.

RAE12MOBILE ROBOTICS   4 0 0 4

COURSEOBJECTIVES
- To recognize and describe the role of unmanned aerial vehicles (UAVs) in past,present, and future society.
- TocomprehendandexplainvariouscomponentsofUAVs.
- Tocomprehendandexplainbasicsofflightandflightcontrol systems.
- Tounderstandanddescribe basicsofunderwaterrobots.

COURSEOUTCOMES
Attheendofthe course,studentwillbeable to
- UnderstandthechallengesindevelopingautonomousmobileRobots.
- AbstractkinematiccontrolofwheeledmobileRobots.
- Understandthechallengesinvolvedinsensoryperceptionformobile Robots.
- DeveloplocalizationandpathplanningalgorithmsformobileRobot navigation.
- Comprehendthechallengesandconfigurationsoflegged,aerialandunderwater Mobile Robots.

UNITI:OVERVIEWANDBACKGROUND
Definitions- History of UAVs - classifications of UAVs scale- lift generation method- contemporary applications- military- government- civil-societal impact and future outlook- operational considerations- liability / legal issues-insurance- ethical implications- human factors- LOS / BLOS.   **(12)**

UNITII:PAYLOADFORUAV
Introduction – Types – Non dispensable Payloads - Electro-optic Payload Systems - Electrooptic Systems Integration - Radar Imaging Payloads - Other Non dispensable Payloads -Dispensable Payloads - Payload Development   **(12)**

UNITIII:UNMANNEDAERIALSYSTEM(UAS)COMPONENTS
Platforms- configurations- characteristics-applications- propulsion- Internal combustion -on- board flight control- payloads- sensing / surveillance- weaponized- delivery- communications- command/control- telemetry - launch / recovery systems- Ground control stations.   **(12)**

UNITIV:UNDERWATERROBOTICS
Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Differentiating Aerial and Underwater Robotics - Overview about Environmental Factors affecting object in water.   **(12)**

UNITV:CONTROLSYSTEMAND MANIPULATOR
Control System and Types of Control Systems in Underwater Robotics - Sensors Connected with the Underwater Robotics - Introduction to Underwater Manipulators - Introduction to Hydraulics on Underwater Vehicles - Applications of Underwater Vehicles. AUTONOMOUSUNDERWATERSYSTEMS:IntroductiontoAUVS-Developmentof

AUVs,ROVin Market -Case Studyon AUVControl System Basics -Case StudyonSubsea Manipulator - Case Study on Technologies Used.   **(12)**

TEXT BOOKS:
1. RolandSiegwant&IllahR.Nourbakhsh,IntroductiontoAutonomousMobile Robots, MIT Press, 2004.

REFERENCEBOOKS:
1. ASATestPrep.RemotePilotTestPrep—UAS:Study&Prepare.Wellfleet Press, 2016. 978-1577151326
2. Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010. 978-0-470-05819-0
3. Baichtal, BuildingYour Own Drones: ABeginners'Guide to Drones, UAVs, and ROVs. Que Publishing,2016. 978-0789755988
4. Beard&McLain,SmallUnmannedAircraft:TheoryandPractice.Princeton University Press, 2012. 978-0691149219
5. Cares & Dickmann, Operations Research for Unmanned Systems. Wiley, 2016. 978-1-118-91894-4
6. GianlucaAntonelli,—UnderwaterRobots‖,Springer,2014.

RAE13VISIONGUIDEDROBOTICS   4   0   0   4

COURSEOBJECTIVES
➢ Toimpartknowledgeinthefieldofcomputervisionappliedtoguidanceof manipulators and mobile Robots.

COURSEOUTCOMES
Atthe endofthecourse,studentwillbeable to
➢ Understandthe foundationsofthefieldofcomputervisionrequiredforRobot vision.
➢ ExplaintheMathematicsandImplementationofvisionguidancefor manipulators.
➢ FormulatethevariouswaystoutilizecomputervisionformobileRobots.
➢ DevelopalgorithmsforMotion analysis.
➢ Apply the computer vision algorithms for suitable applications involving Manipulators and mobile Robots.

UNITI:INTRODUCTION
Vision for robot manipulation and navigation-Motivation. Modeling velocity of a rigidobject-Camera configurations in vision guided Robots-Triangulation-Vision based pose estimation.
(12)

UNITII:VISUALSERVOING
Mathematical formulation of visual servo problem-classification of visual servoing architectures-Image based visual servoing (IBVS), Interaction matrix derivation-Geometrical interpretation of IBVS, stability analysis-Case study: IBVS with stereo vision system-IBVS with other geometrical features, direct estimation-Position based visual servoing: Pointfeature based motion, pose based motion-Calibration for visual servoing systems**. (12)**

UNITIII:VISIONFORMOBILE ROBOTS
Introduction to simultaneous localization and mapping, visual SLAM (VSLAM)-VSLAM approaches-Introduction to visual odometry (VO).VO: Motion from Image feature correspondences, motion from 3D structure. Comparison between VSLAM and VO calibration techniques-Case study of VSLAM and VO application.   **(12)**

UNITIV:MOTIONANALYSIS
Formulation of the motion analysis-Motion field of Rigid objects, Aperture problem-Optical flow and motion field, brightness constancy equation and validity-Estimating motion field: Differential techniques, feature based techniques.Target tracking: Challenges and solutions, Kalman filtering basics-Kalman tracking.   **(12)**

UNITV:ADVANCEDTOPICS
Hybridvisualservoing,partitionedvisualservoing,switching -schemesinvisualservoing. Joint space control of eye-in-hand and eye-to-hand systems-Motion based segmentation. Structurefrommotion(SFM),multi-view SFM-3-D structureandmotionfrommotion field.
(12)

TEXT BOOK:
1. EmanueleTrucco,AlessandroVerri,―IntroductoryTechniquesFor3DComputer Vision‖, Prentice Hall of India, April 11-13, 2018.

REFERENCEBOOKS:

1. BrunoSiciliano,OussamaKhatib,―SpringerHandbookofRobotics‖,Springer,2008.
2. D. Scaramuzza and F. Fraundorfer, "Visual Odometry [Tutorial]", IEEE Robotics &Automation
3. Magazine,vol.18,no.4,pp.80-92,December,2011.
4. F. FraundorferandD.Scaramuzza,"VisualOdometry:PartII:Matching,Robustness, Optimization, 1 EE Robotics & Automation Magazine, Vol 18, Issue 4, 2011.
5. Applications",IEEERoboticsandAutomationMagazine,vol.19,no.2,pp.78-90, June,2012.

RAE14MEDICALROBOTICS   4   0   0   4

COURSEOBJECTIVES
- ➢ Identify and describe different types of medical robots and their potential applications.
- ➢ Know basic concepts in kinematics, Dynamics, and control relevant to Medical Robotics.
- ➢ Develop the Analytical and Experimental skills necessary to Design and Implement robotic assistance for both minimally invasive surgery and Image-guided interventions.
- ➢ Be familiar with the state of the art in applied medical robotics and medical robotics research.
- ➢ Understandthevariousrolesthat roboticscan playin healthcare.

COURSEOUTCOMES
- ➢ Thestudents willbeabletosimulate a MIS procedureandbe awareofthestate- of art in surgical and oncology robotics.
- ➢ Studentsshouldbeabletohaveafundamentalunderstandingofrobotkinematics and dynamics.
- ➢ Understandthechallengesinthedesignofamedicalroboticsystemgiventhe specific requirements for a particular application.
- ➢ Appreciatethedesign,development,andevaluationofamedicalroboticsystem.

UNITI:INTRODUCTION
Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation andProsthetics - State of art of robotics in the field of healthcare.
                                                  (12)UNI

T II: LOCALIZATION AND TRACKING
Position sensors requirements - Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic - Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking systems - Hybrid systems.   **(12)**

UNITIII:SURGICALROBOTICS
Minimally invasive surgery and robotic integration – surgical robotic sub systems - synergistic control.Control Modes –Radiosurgery-Orthopedic Surgery-Urologic Surgery and Robotic Imaging - Cardiac Surgery – Neurosurgery – case studies.   **(12)**:

UNITIV:REHABILITATION
RehabilitationforLimbs-Brain-MachineInterfaces-SteerableNeedles–casestudies. Robots in Medical Care**:** Assistive robots –types of assistive robots – case studies.**(12) UNIT V:**

DESIGN OF MEDICAL ROBOTS
Characterization of gestures to the design of robots- Design methodologies- Technological choices- Security.   **(12)**

TEXT BOOKS:
1. MarkW.Spong,SethHutchinson,andM.Vidyasagar,―RobotModelingandControl‖, Wiley Publishers, 2006.
2. PaulaGomes,"MedicalroboticsMinimallyinvasivesurgery",Woodhead,2012.

REFERENCEBOOKS:
1. AchimSchweikard, FlorisErnst,―MedicalRobotics‖,Springer, 2015.
2. JocelyneTroccaz,―Medical Robotics‖,Wiley-ISTE,2012.
3. VanjaBonzovic,‖MedicalRobotics‖,I-techEducationpublishing, Austria,2008.

RAE15 – INDUSTRIAL IOT AND AUTOMATION   4 0 0 4

COURSE OBJECTIVES
➢ The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.

COUESE OUTCOMES
After the completion of this course, the students will be able to:
➢ Understand internet of Things and its hardware and software components
➢ Interface I/O devices, sensors & communication modules
➢ Remotely monitor data and control devices
➢ Develop real life IoT based projects

UNIT I: INTRODUCTION
Modern instrumentation and control systems – Terminology – Topology – Mechanisms - Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 Interface standard – EIA-485 interface standard – Current loop and EIA-485 converters - Fibre optic cable components and parameters – Basic cable types – Connection fibers – troubleshooting.   (12)

UNIT II: COMMUNICATION BUS PROTOCOLS
Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i)-DeviceNet: Physical layer – Topology – Device taps –Profibus PA/DP/FMS: Protocol stack – System operation. CAN BUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – detection – processing – Introduction to CAN 2.0B.   (12)

UNIT III: ETHERNET SYSTEMS
IEEE 802.3 – Physical layer - Medium access control – Collisions - Ethernet design rules - Fast and gigbit Ethernet systems - design considerations - Internet layer protocol - UDP - TCP/IP - ProfiNet - LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet.   (12)

UNIT IV: WIRELESS COMMUNICATIONS
Radio spectrum – Frequency allocation – Radio modem – Inter modulation – Implementing a radio link – RFID: Basic principles of radio frequency identification – Transponders – Interrogators, Wireless HART.   (12)

UNIT V: APPLICATIONS
Automotive communication technologies – Design of automotive X-by-Wire systems, - The LIN standard – The IEC/IEEE Train communication network: Applying train communication network for data communications in electrical substations.
(12)

TEXTBOOKS:
1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, ―Practical Industrial Data Networks: Design, Installation and Troubleshooting‖, Newnes (Elsevier), 2004.
2. Dominique Paret, ―Multiplexed Networks for Embedded Systems‖, John Wiley & Sons, 2007.

REFERENCEBOOKS:
1. Richard Zurawski, ―The Industrial Communication Technology Handbook‖, Taylor and Francis, 2005.
2. Deon Reynders and Edwin Wright,―PracticalTCP/IP and EthernetNetworking‖,IDC Technologies, 2006.
3. JamesPowell,HenryVandelinde,―CatchingtheProcessFieldbusanIntroduction toPROFIBUSforProcessAutomation", Momentum Press, 2013.
4. AlbertLozano-Nieto,―RFIDDesignFundamentalsandApplications‖,CRCPress,2011.

RAE16 OPERATIONS RESEARCH   4   0   0   4

COURSE OBJECTIVES
- ➢ To provide knowledge and training in applying optimization techniques under limited resources for the engineering and business problems.

COURSE OUTCOMES
- ➢ Upon completion of this course, the students can able to use the optimization techniques for use of engineering and Business problems.
- ➢ Students will have the ability to develop Mathematical Model for Engineering problems.

UNIT I: LINEAR MODELS

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis – Case studies.

(12) UNI

T II: TRANSPORTATION MODELS AND NETWORK MODELS

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models   **(12)**

UNIT III: INVENTORY MODELS

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice– Case studies on Inventory   **(12)**

UNIT IV: QUEUEING MODELS

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation case studies.   **(12)**

UNIT V: DECISION MODELS

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem – case studies.   **(12)**

TEXT BOOKS:
1. Hillier and Libeberman, ―Operations Research‖, Holden Day, 2005
2. Taha H.A.,―Operations Research‖, Sixth Edition, Prentice Hall of India, 2003.
3. R.Panneerselvam,‖Operations Research‖, 2nd edition, Published 2006.

REFERENCE BOOKS:
1. Bazara M.J., Jarvis and Sherali H.,―Linear Programming and Network Flows‖, John Wiley, 2009.
2. Budnick F.S.,―Principles of Operations Research for Management‖, Richard D Irwin, 1990, Nov 17, 2018.
3. Philip D.T. and Ravindran A.,―Operations Research‖, John Wiley, 1992, 2007.
4. Shennoy G.V. and Srivastava U.K., ―Operation Research for Management‖, Wiley Eastern, 1994, 2013.
5. Tulsian and Pasdey V.,―Quantitative Techniques‖, Pearson Asia, 2002.

<center>**RAE17COMPUTERINTEGRATED MANUFACTURING   4   0   0   4**</center>

COURSEOBJECTIVES
- ➢ To understand the application of computers in various aspects of Manufacturingviz., Design, Process planning, Manufacturing cost, Layout & Material Handling system.

COURSEOUTCOMES
- ➢ ExplainthebasicconceptsofCAD,CAMinComputerIntegratedManufacturing systems.
- ➢ Summarize the production planning and control and Computerized process planning by differentiating the different coding systems used in group technology.
- ➢ ExplaintheconceptsofFlexiblemanufacturingsystem(FMS)andAutomatedguided vehicle (AGV) system.
- ➢ ClassificationofrobotsusedinIndustrialapplications.

UNITI:INTRODUCTION
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control-Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance– Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production – case studies.   **(12)**

UNITII:PRODUCTIONPLANNINGANDCONTROLANDCOMPUTERISED PROCESS PLANNING
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning andMaster Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop FloorControl-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.   **(12)**

UNITIII:CELLULARMANUFACTURING
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell –Hollier Method – Simple Problems.   **(12)**

UNITIV:FLEXIBLEMANUFACTURINGSYSTEM(FMS)ANDAUTOMATED GUIDED VEHICLE SYSTEM (AGVS)
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS PlanningandControl –Quantitativeanalysisin FMS – SimpleProblems.AutomatedGuided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.   **(12)**

UNITV:INDUSTRIALROBOTICS
Robot Anatomyand Related Attributes – Classification of Robots- Robot Control systems – EndEffectors–SensorsinRobotics–RobotAccuracyandRepeatability-IndustrialRobot

Applications–RobotPartProgramming–RobotAccuracyandRepeatability–Simple Problems.
(12)

TEXT BOOK:
1. Mikell.P.Groover―Automation,ProductionSystemsandComputerIntegrated Manufacturing‖, Prentice Hall of India, 2008.
2. RadhakrishnanP,SubramanyanS.andRajuV.,―CAD/CAM/CIM‖,2ndEdition, New Age International (P) Ltd, New Delhi, 2000

REFERENCEBOOKS:
1. PeterSmid,―CNCprogrammingHandbook‖3rdedition,Ny2008.

RAE18 RELIABILITY AND QUALITY CONTROL   4   0   0   4

COURSE OBJECTIVES
This course introduces students to concepts and methods of modern statistical quality control.
- Students learn to apply standard quality control tools.
- They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations.
- They learn theory and methods for analyzing the performance of different quality control tools used in Industry practices.
- To learn some softwares related to statistics & Quality control.

COURSE OUTCOMES
- Principles of probability and statistics and their appropriate application to quality engineering, including use of computer software.
- Through homeworks and computer projects, students learn to formulate and solve quality characteristic monitoring problems.
- Assignment and class discussion on relationship between product quality, public safety, liability, and professional ethics.
- Use of interactive PC - based computer programs for statistical analysis. MATLAB is introduced in class, students may also use Excel or specialized mathematical and statistical packages.

UNIT I: STATISTICAL PROCESS CONTROL
Chance and assignable causes of quality variation, statistical basis of the control charts- Basic principles, choice of control limits, Analysis of patterns on control charts.**(12)**

UNIT II: CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES
chart, R chart, chart, p chart, np chart, c chart, and u chart.   **(12)**

UNIT III: ACCEPTANCE SAMPLING
Types of sampling plans, lot formation, single sampling plans for attributes, double, multiple and sequential sampling plans, acceptance sampling by variables, chain sampling, continuous sampling, skip lot sampling plans.   **(12)**

UNIT IV: BASIC RELIABILITY MODELS
The failure distribution – Terminologies in Reliability, the reliability function, mean time to failure, Hazard rate function, bathtub curve, conditional reliability. Constant failure rate model (MTF): Exponential reliability function. Time - dependent Weibull failure model, Time - Dependent normal failure model.

(12)
UNIT V: RELIABILITY OF SYSTEMS
Serial configuration, parallel configuration, combined series, parallel systems - k out of n: system - system structure function, minimal cuts, minimal paths, common mode failures, three state devices.   **(12)**

TEXT BOOKS:

1. DouglasCMontgomery,IntroductiontoStatisticalQualityControl,WileyIndia, New Delhi, 2008.
2. Charles E. Ebeling, Introduction to Reliability and MaintainabilityEngineering,Tata Mc –Graw Hill, New Delhi, 2010. 55

REFERENCEBOOKS:

1. Eugene L Grant, Richard S Leavenworth, Statistical Quality Control, Tata Mc- Graw Hill, New Delhi, 2011.
2. DaleHBesterfield,QualityControl,PearsonEducation,NewDelhi,2008.
3. HoangPham,HandbookofReliabilityEngineering,Springer-Verlag,NewYork, 2006.

RAE19 PROCESS PLANNING AND COST ESTIMATION   **4   0   0   4**

COURSE OBJECTIVES

- To introduce the process planning concepts to make cost estimation for various products after process planning.

COURSE OUTCOMES

Upon the completion of this course the students will be able to

- Select the process, equipment and tools for various industrial products.
- Prepare process planning activity chart for several jobs.
- Ability to learn the concept of cost estimation for various operations.
- Compute the job order cost for different types of shop floor activities.
- Calculate the machining time for various machining operations.

UNIT I: PROCESS PLANNING

Introduction- Process & Production Planning, Process Planning & Concurrent Engineering- Types of production- standardization- Production design & selection. Design and Concepts of Process Plan: Selection of processes, tools, cutting parameters & machine tools -Grouping of processes- Sequencing of operations- Selecting primary manufacturing processes for rough & refined needs Process capability, Process Charts. **(12)**

UNIT II: MANUAL AND COMPUTER AIDED PROCESS PLANNING

Retrieval type/variant approach, group technology – generative approach, logics decision tress and tables, axiomatic approach – AI expert systems – feature recognition –applications. Estimating and Costing: Concepts, differences, different costing methods – classification of costs – cost grid-problems.   **(12)**

UNIT III: DIRECT AND INDIRECT COST COMPONENTS

Labour cost–direct, indirect–estimation–labour norms–time study rating – labour cost variances; material cost–direct, indirect–estimation–material issue valuation – material cost variances–problems. Overhead cost - Elements – factory, administrative, sales and distribution expenses–methods of absorbing overheads – direct labour, direct Material, Machine Hour Rate methods – depreciation – methods –accounting for service department expenses – problems.   **(12)**

UNIT IV: COST CALCULATIONS

Machined components, welded components, forged components, powder metallurgy parts, calculation of sales cost, case studies, use of computers in cost estimation, cost of rejection. Optimum Machining Conditions: Taylor_s equation, deriving the equation for optimum economic cutting velocity– selection of cutting speed for optimum cost, problems process capability analysis.   **(12)**

UNIT V: BREAK EVEN ANALYSIS

Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications - Linear, multi product break-even analysis. Cost Management: Learning curves, product life cycle cost analysis -Tools and techniques–activity based costing - concepts, cost drivers; introduction to target costing - need and applications.   **(12)**

TEXT BOOKS:

1. KannappanD,―MechanicalEstimatingandCosting‖,TataMcGrawHill,New Delhi, 2003.
2. KesavonRandothers,―ProcessPlanningandCostEstimation‖,NewAge International, Chennai, 2005.
3. R.Panneerselvam&P.Sivasankaran–Process&CostEstimation,PH|Ltd, 2018.

REFERENCEBOOKS:

1. Thomas E. Vollmann et al., ―Manufacturing Planning and Control Systems ―, Galgotia Publications, Delhi, 2018.
2. SamuelEilon,―ElementsofProductionPlanningandControl‖,MacMillan,London. ASME, ―Manufacturing Planning and Estimation-Hand Book‖, McGraw Hill, New Delhi, 2018, Dec 26.
3. Frederic C Jelen and James H Black, ―Cost and Optimization Engineering‖, McGraw Hill, New Delhi, 2007, May 31.

RAE20 MICRO AND NANO ELECTROECHANICAL SYSTEMS   4   0   0   4

COURSE OBJECTIVES
- To understand the detailed introduction of the Nanoscale systems.
- To understand the concepts of Quantum Dots and Synthesis of Nanostructure Materials.

COURSE OUTCOMES
On successful completion of the course students will be able to:
- Have a knowledge of Nanoscience and nanotechnology including theory & practical application.
- Potentially apply the concepts of Quantum Dots and Synthesis of Nanostructure Materials in research projects.
- Understanding scaling of Electronic components for producing MEMS switches.
- Propose novel ideas using the concepts of characterization and Nanotechnology application.

-

UNIT I: NANOSCALE SYSTEMS
Length, energy, and time scales - Quantum confinement of electrons in semiconductor nanostructures: Quantum confinement in 3D, 2D, 1D and zero dimensional structures -Size effect and properties of nanostructures- Landauer - Buttiker formalism for conduction in confined geometries - Top down and Bottom up approach.   **(12)**

UNIT II: QUANTUM DOTS
Excitons and excitonic Bohr radius – difference between nanoparticles and quantum dots - Preparation through colloidal methods - Epitaxial methods- MOCVD and MBE growth of quantum dots -current-voltage characteristics- magneto tunneling measurements - spectroscopy of Quantum Dots: Absorption and emission spectra - photo luminescence spectrum - optical spectroscopy - linear and nonlinear optical spectroscopy.   **(12)**

UNIT III: INTRODUCTION TO MEMS AND NEMS
working principles as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor),micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Pizoresistivity, Pizoelectricity and thermoelectricity, MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.

                                                                                    (12)
UNIT IV: INTRODUCTION ELECTRONIC SCALING
Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single-Electron Transistor:The Single-Electron Transistor Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs,Coulomb Blockade in a Nanocapacitor, Molecular SETs and Molecular Electronics.   **(12)**

UNIT V: NANOTECHNOLOGY APPLICATIONS

Applications of nanoparticles, quantum dots,nanotubes and nanowires for nano device fabrication – Single electron transistors, coulomb blockade effects in ultra-small metallic tunnel junctions - nanoparticles based solar cells and quantum dots based white LEDs –CNT based transistors – principle of dippenlithography. **(12)**

TEXT BOOKS:
1. G.Timp,Nanotechnology.Editor,AIPpress,Springer-Verlag, NewYork,2007
2. StephenD.Senturia,MicrosystemDesign,KluwerAcademicPress,2005.
3. MarcMadou,Fundamentalsofmicrofabrication&Nanofabrication,2013, March 30.

REFERENCEBOOKS:
1. HandbookofNanostructuredMaterialsandTechnology,Vol.1-5, Editor:-Hari Singh Nalwa; Academic Press, USA(2000).
2. Handbookof Nanoscience,EngineeringandTechnology(The Electrical Engineering handbook series), Kluwer Publishers,2002
3. C.J. Brinker, G.W. Scherrer andSol-Gel Science, Academic Press, Boston, Dec 11, 2016.
4. Nanoscalecharacterizationofsurfaces&interfaces,NJohnDinardo,Weinheim Cambridge: Wiley-VCH, 2nd ed.,2000.
5. T. Fukada&W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 2012.
6. 4.JulianW.Gardnes,VijayK.Varda,MicrosensorsMEMS&SmartDevices, 2001.

RAE21COGNITIVE ROBOTICS   4 0 0 4

COURSEOBJECTIVES
- ➢ TounderstandthefundamentalsofBiometricterms.
- ➢ ToacquireknowledgeonFingerprintIdentification,IrisRecognition,Face Recognition and learn about their real time applications.
- ➢ ToframeideasonworkingofVoiceScanandIntegratingitwithotherBiometric systems.

COURSEOUTCOMES
- ➢ Apply their knowledge of machine vision and robot kinematics to create computer programsthatcontrolmobilerobotsandrobotarms,enablingtherobotstorecognize and manipulate objects and navigate their environments.
- ➢ Explain how a robot can be designed to exhibit cognitive goal-directed behaviour throughtheintegrationofcomputermodelsofvisualattention,reasoning,learning, prospection, and social interaction.
- ➢ Createcomputerprogramsthatrealize limited instancesofeachofthesemodels.

UNITI:BIOMETRICFUNDAMENTALS
Key Biometric terms and Processes – Definitions-verification and identification – Matching, Accuracy in Biometric Systems – False match rate - False on match rate - Failure to enrollrate – Derived metrics - An Introduction to Biometric Authentication Systems- a taxonomy of application environment, a system model, biometrics and privacy. **(12)UNIT**
II: FINGERPRINT IDENTIFICATION TECHNOLOGY
History, Components, Application of Fingerprints, The Technology- Finger Scan Weaknesses, Criminal Applications, Civil Applications, Commercial Applications, Technology Evaluation of Fingerprint Verification Algorithms. **(12)UNIT**
III: IRIS RECOGNITION
Introduction, Anatomical and Physiological underpinnings, Components, Sensing, Iris Scan Representation and Matching, Iris Scan Strengths and Weaknesses, System Performance, Future Directions. **(12)**
UNITIV:FACERECOGNITION
Introduction, components, Facial Scan Technologies, FaceDetection, Face Recognition-Representation and Classification, Kernel- based Methods and 3D Models, Learning theFace Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition. **(12)**
UNITV:VOICE SCAN
Introduction,Components, FeaturesandModels, AdditionMethodformanagingVariability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NISTSpeakerRecognitionEvaluationProgram,BiometricSystem Integration–casestudies softwares (Voice Recognition) **(12)**

TEXT BOOKS:
1. JamesWayman&AnilJain,BiometricSystems –Technology,DesignandPerformance Evaluation, Springer-verlag London Ltd, USA, 2005
2. SanirNanavati,MichaelThieme, Biometrics Identity Verification in aNetworked world, Wiley Computer Publishing Ltd, New Delhi,2003.

REFERENCEBOOKS:
1. JohnD.WoodwordJr.,Biometrics,DreamtechPress,NewDelhi,2003.

RAE22MACHINELEARNINGFORROBOTICS   4 0 0 4

COURSEOBJECTIVES
- Tointroduce studentsaboutthe basicconceptsandtechniquesofMachine Learning
- Tobecomefamiliarwithregressionmethods,classificationmethods,clustering methods.
- TobecomefamiliarwithDimensionalityreductionTechniques.

COURSEOUTCOMES
Studentswillbeableto:
- GainknowledgeaboutbasicconceptsofMachineLearningEnvironment.
- Identifymachinelearningtechniquessuitableforagivenproblem.
- Solvethe problemsusingvariousmachinelearningtechniques.
- ApplyDimensionalityreduction techniques.
- Designapplicationusingmachinelearningtechniques.

UNITI:INTRODUCTION
Machine learning – Varieties of Machine learning – Learning Input- Output functions:Types of learning – Input Vectors – Outputs – Training regimes – Noise – Performance Evaluation. Foundations of Supervised Learning: Decision trees and Inductive bias – Geometry and nearest neighbors–Logistic regression – Perceptron – Binary classification.

        (12)

UNITII:ADVANCEDSUPERVISEDLEARNING:
Linear models and gradient descent – Support Vector machines – Naïve Bayes models and probabilistic modeling – Model selection and feature selection – Model Complexity and Regularization.   **(12)**

UNITIII:CASESTUDY1
Line following using Supervised Learning techniques. Goal: A simulation model will be developed for understanding both regression and classification techniques. A framework needto befixed andthecomplexityof themodel will be variedin orderto analyze the effect on the system. The effectiveness of the Biasvariance has to be studied.   **(12)**

UNITIV:UNSUPERVISEDLEARNING
Curse of dimensionality, Dimensionality Reduction, PCA, Clustering – K-means – Expectation Maximization Algorithm – Mixtures of latent variable models – Supervised learning after clustering – Hierarchical clustering – Case studies.   **(12)**

UNITV:NEURALNETWORKS
Network Representation, Feed-forward Networks, Back propagation, Gradient-descent method. CASE STUDY: Obstacle avoidance and navigation of a mobile robot in an unknown environment with the help of Neural Network. Goal: A hands-on experience with real world noisydata. The stochastic PCA and the PCA neural network are used to find low dimensional features. The low dimensional features can be used to build a feed-forward neural network in order to ascertain automatic navigational queries like: Where are the free spaces? How can robot reach the goal?   **(12)**

TEXT BOOKS:

1. TomMitchell,MachineLearning_,McGrawHill,2015.
2. Peter Flach,_Machine Learning:The Art andScience ofAlgorithmsthatmake sense of data_, Cambridge, 2014.
3.

REFERENCEBOOKS:

1. HalDaumeIII,_AcourseinMachineLearning_,Todo,2015.
2. EthemAlpaydin,_IntroductiontoMachineLearning_,TheMITPress,2004
3. DavidMacKay, InformationTheory, Inference and LearningAlgorithms_, Cambridge, 2003

RAE23MICROBOTICS   4   0   0   4

COURSEOBJECTIVES
- Theobjectiveofthiscourseistoexposestudentstothefundamentalaspectsofthe emerging field of microbotics.
- This includes a focus on physical laws that predominate at the microscale, technologiesforfabricatingsmalldevices,bio-inspireddesign,andapplications ofthe field.

COURSEOUTCOMES
Studentswillbeableto:
- Formulatethespecificationsofamechatronicsystem.
- Designofmechatronicsystems(choice ofsensors,actuators,embeddedsystems)
- Explainand applytheconceptsofmass, energy,and momentum balance.
- Modeldesign,andoptimizeenergyconversionsystemsandIndustrial processes.
- Characterizeexperimentallythesteady-stateordynamicresponseofsolidsand fluids.
- Applyadapt,andsynthesizelearnedengineeringskillstocreatenovel solutions.
- ExpoundandIteratemultipledesignconceptsbasedonthemodelsand simulations.
- Describeinscientifictermsandapplytheprinciplesoftribologyandcontact mechanics.

UNITI:INTRODUCTION
MST(MicroSystemTechnology)–Micromachining-WorkingprinciplesofMicrosystems -ApplicationsofMicrosystems-Case studies.   **(6)**

UNITII:SCALINGLAWSANDMATERIALSFORMEMS
Introduction - Scaling laws - Scaling effect on physical properties, scaling effects onElectrical properties, scaling effect on physical forces. Physics of Adhesion - Silicon- compatible material system - Shape memory alloys - Material properties: Piezoresistivity, Piezoelectricity and Thermoelectricity.   **(12)**

UNITIII:FLEXURES,ACTUATORSANDSENSORS
Elemental flexures - Flexure systems - Mathematical formalism for flexures.Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuators. Electromagnetic sensors, Optical-based displacement sensors, Motion tracking with microscopes.   **(12)**

UNITIV:MICROROBOTICS
Introduction, Task specific definition of micro-robots - Size and Fabrication Technology based definition of microrobots - Mobility and Functional-based definition of microbot - Applications for MEMS based microbots.   **(12)**

UNITV:IMPLEMENTATIONOF MICROROBOTS
Arrayed actuator principles for microbotic applications – Micro-robotic actuators -Design of locomotivemicrobotdevicesbasedonarrayedactuators.Microboticsdevices:Micro-

grippersandothermicro-tools-Micro-conveyors- Walking MEMSMicro-robots–Multi- robot system: Microbot powering, Microbot communication**.**   **(12)**

UNITVI:MICROFABRICATIONANDMICROASSEMBLY

Micro-fabrication principles - Design selection criteria for micromachining-Packaging and Integration aspects – Micro-assembly platforms and manipulators**.**   **(6)**

TEXT BOOKS:
1. MohamedGad-el-Hak,―TheMEMS Handbook‖,CRCPress,NewYork, 2002.
2. Yves Bellouard, ―Microrobotics Methods and Applications‖, CRC Press, Massachusetts, 2011.

REFERENCEBOOKS:
1. NadimMalufandKirtWilliams,‗‖AnIntroductiontoMicroelectromechanical systems Engineering‖, Artech House, MA, 2002.
2. Julian W Gardner, ―Microsensors:Principles and Applications‖, John Wiley& Sons, 2013.

RAE24 COLLOBORATIVE ROBOT (COBOT)   4   0   0   4

COURSE OBJECTIVES
- ➢ To gain the knowledge on basics of Ladder Logic, Basic programming, Safety for Hydraulics and Pneumatics, Robot Safety, Robotic Drives, Hardware, and Components, Robot Installations, Vision Systems, and Robot Troubleshooting.

COURSE OUTCOMES
Students will be able to:
- ➢ Gain a greater understanding of Industrial robotics, including types, applications, and programming methods.
- ➢ Understand the importance of "Robot Safety" by reviewing and demonstrating the different ways to prevent robot accidents.
- ➢ Gain a greater understanding of the physical components of industrial and collaborative robots, and how these components operate and allow the robot to perform work.
- ➢ Demonstrate the basic steps for installing and maintaining industrial and/or collaborative robots.
- ➢ Learn the use of a systematic approach in solving issues that cause robotic malfunction.

UNIT I: REVIEW OF THE BASICS OF INDUSTRIAL ROBOTICS
Identify and describe the basic components of a robot's body and arms- Description of the axis of movement for the robotic arm - Describe the coordinate systems used to program a robot's movement, and review stationary and mobile industrial robots and appropriate applications for each.   **(12)**

UNIT II: ROBOTIC DRIVES, HARDWARE AND COMPONENTS
Describe and demonstrate items used in robots such as frames and frame material, robot joints, bearings, hydraulics drives, pneumatic drives, servomotors and encoders, transmissions, ballscrews, sensors, wiring and hoses- the methods robotic axis control, and describe sensors for robots.   **(12)**

UNIT III: ROBOT INSTALLATION
Packing/unpacking and transporting the robot, installing the robot and the controller, making connections of power, grounding and other cables, robotic start-up, writing and loading programs, and troubleshooting the robotic assembly.   **(12)**

UNIT IV: VISION SYSTEMS
Vision system for Industrial Robots including the concepts of linear array, matrix arrays, machine vision, pixel display, camera mounting, image intensity, Vidicon vs. Solid State cameras, lighting, lighting devices, laser vision and machine vision applications. **(12)**

UNIT V: ROBOT TROUBLESHOOTING
Basic troubleshooting process, useful troubleshooting tools, and common robotic malfunction root causes and corrective actions. Collection and organization of troubleshooting information, as well as the use of troubleshooting manuals and flowcharts,

assessment of troubleshooting costs, working backwards, the 5 Whys Technique, implementation of corrective actions, temporary vs. permanent corrective actions, and system testing following corrective action. **(12)**

TEXT BOOKS:
1. M.A. Reshkin, J.E. Colgate, C.A. Moore, Cobot Architecture, I EEE Transaction on Robotics & Automation, Vol 17, issue 4, 2001.

REFERENCES:
1. ISO10218Part1& Part 2 (2011)
2. ANSI/RIAR15.062012
3. VDMA position-paper ―Safety in Human-Robot Collaboration‖ (http://rua.vdma.org/en/article/-/articleview/4217015)

RAE25 PRODUCT DESIGN AND DEVELOPMENT   4 0 0 4

COURSE OBJECTIVES
- ➢ The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product as and how to incorporate them suitably in product.

COURSE OUTCOMES
- ➢ The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

UNIT I: INTRODUCTION

Need for IPPD (Integrated Product and Process Development) – Strategic importance of Product development – Integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements–Organization–process management and improvement –Plan and establish product specifications. **(12)**

UNIT II: CONCEPT GENERATION AND SELECTION

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits. **(12)**

UNIT III: PRODUCT ARCHITECTURE

Implications – Product change – variety – component standardization – product performance –manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications. **(12)**

UNIT IV: INDUSTRIAL DESIGN

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools –Simulating product performance and manufacturing processes electronically– Need for industrial design – Impact – Design process – Investigation for Industrial design – Impact – Design process –Investigation of customer needs – conceptualization – refinement –management of the industrial design process – Technology driven products – user – driven products – assessing the quality of industrial design. **(12)**

UNIT V: DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT

Definition – Estimation of Manufacturing cost – Reducing the component costs and assembly costs –Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes –Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution. **(12)**

TEXT BOOK:

1.KariT.UlrichandStevenD.Eppinger,‖ProductDesignandDevelopment‖, McGraw-
HillInternational Edns. 2008.

REFERENCEBOOKS:

1. Kemnneth Crow, ―Concurrent Engg./Integrated Product Development‖, DRM
Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop
Book, 2002
2. Staurt Pugh, ―Tool Design –Integrated Methods for Successful Product
Engineering‖, Addison Wesley Publishing, New york, NY, 2006.

RAE26LEANMANUFACTURING   **4   0   0   4**

COURSEOBJECTIVES
- ➢ Tointroducethestudentstheleanmanufacturingconcepts
- ➢ Tounderstand group technologyand useof it for part identification
- ➢ Tounderstandvalue streammappinginleanmanufacturing.
- ➢ Toteachthetoolsandmethodusedinlean manufacturing
- ➢ Tointroduce conceptofTotalProductiveMaintenanceandothersystem

COURSEOUTCOMES
- ➢ Abilityto implement leanmanufacturingconceptsinindustries.
- ➢ Abilityto applygroup technologyand cellular layout in manufacturing.
- ➢ Abilitytoapplyvalue stream mappingandtake timecalculations.
- ➢ Abilitytouse theleanmanufacturingtoolsand method.
- ➢ Abilityto applytotal productive maintenanceconceptsin industries.

UNITI:INTRODUCTION:

Origins and objectives of lean manufacturing – lean process,3M concept key principles and implications of lean manufacturing – traditional Vs lean manufacturing characteristics–roadmap for lean implementation and lean benefits - study of Ford and Toyota production systems - JIT manufacturing, Lean building blocks. LEAN MANUFACTURING CONCEPTS:Valuecreationandwasteelimination –seventypesofwaste –pullproduction-different models of pull production -the Kanban system-continuous flow-the continuous improvement process / Kaizen-Worker involvement. Design of Kanban quantities – Leveled production - tools for continuous improvement.   **(12)**

UNITII:GROUPTECHNOLOGYANDCELLULARLAYOUT
JIT with cell manufacturing – part families- production flow analysis – Composite part concept – machine cell design – quantitative analysis – case studies – single piece flow.**(12)**

UNITIII:VALUESTREAMMAPPING:
The value stream– benefits mapping process - the current state map–mapping icons - mapping steps.VSM exercises - Take time calculations.   **(12)**

UNITIV:LEANMANUFACTURINGTOOLSANDMETHODOLOGIES
: Standardized work–standard work sequence timing and working progress .Quality atsource – Autonomation /Jidoka, Visual management system, Mistake proofing / Poka-Yoke. 5S technique – Elements and waste elimination through 5S, advantages and benefits - 5S- audit - visual control aids for improvement, flexible work force   **(12)**

UNITV:TOTALPRODUCTIVEMAINTENANCE
Goals and benefits – Hidden factory, the six big losses, types of maintenance. Overall equipment effectiveness - pillars of TPM and implementation. Change over and set up timer education techniques. Temple of quality, OEE calculations. Reconciling Lean with other systems:StudyofleanSix-sigma andleandesign –leanandERP-leanwithISO9001:2000 - administrative lean.   **(12)**

TEXT BOOKS:
1. MichealWader,―LeanTools:APocketguidetoImplementingLeanPractices‖, Productivity and Quality Publishing, 2007.
2. William M Feld, ―Lean Manufacturing: Tools, Techniques and How to use them‖, APICS, 2001/2000.
3. DennisPHobbs,―LeanManufacturingImplementation‖,LeverageLearning Publications, 2009.
4. GopalakrishnanN,―SimplifiedLeanManufacture‖,PHILearningPvtLtd, 2010-14-2

REFERENCEBOOKS:
1. RichardBChase―ProductionandOperationsManagement‖,McGrawHill,2003
2. TaiichiOhno,―ToyotoProductionSystems:BeyondLargeScaleProduction‖,Productivity Press, 1988.
3. Askin R G and Goldberg J B,― Design and Analysis of Lean Production Systems‖, John Wiley and Sons, 2003.
4. MahadevanB,―OperationsManagement‖,Pearson,2010

RAE27-ENTREPRENEURSHIP DEVELOPMENT   4   0   0   4

COURSEOBJECTIVES
  ➢ To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurialskillsandunderstandingtoruna businessefficientlyand effectively.

COURSEOUTCOMES
  ➢ Uponcompletionof the course,students willbe abletogainknowledgeandskills needed to run a business successfully.
  ➢ Abilitytorecallthe basicsofentrepreneurship
  ➢ Abilitytodevelopa businessmodel
  ➢ Abilityto identifyformsof businessorganization
  ➢ Abilitytodeterminethe financialneed fornew Business
  ➢ Abilitytoapplyindustry,competitorandmarketAnalysis

UNITI:INTRODUCTIONTOENTREPRENEURSHIP
Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance or Entrepreneurship. Creativity and Innovation: The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas– Creative Problem Solving – Entrepreneurial Process. **(12)**

UNIT II: DEVELOPING AN EFFECTIVE BUSINESS MODEL
The Importance of Business Model – Starting a small scale industry - Components of an Effective Business Model. Appraisal of Projects: Importance of Evaluating various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques.
(12)

UNITIII:FORMSOFBUSINESSORGANIZATION
Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companiesand Cooperatives. **(12)**

UNITIV:FINANCINGTHENEWVENTURE
Determining Financial Needs – Sources of Financing – Equity and Debt Funding – Case studies in Evaluating Financial Performance. **(12)**

UNITV:THEMARKETINGFUNCTION
Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – TheMarketing Process. Intellectual Property Protection and Ethics: Patents – Copyright - Trademark- Geographical indications – Ethicaland social responsibilityand challenges. **(12)**

TEXT BOOKS:
  1. Donald F.Kuratko and Richard M. Hodgetts, ―Entrepreneurship‖, South-Western‖ -a contemporary approach south western college publication, 6th edition 2003.
  2. Vasant Desai, ―The Dynamics of Entrepreneurial Development and Management‖, Himalaya Publishing House, 2010.edition-5-2009.

REFERENCEBOOKS:

1. GuptaS.L.,ArunMittal,―EntrepreneurshipDevelopment,InternationalBookHouse, 2011.
2. SudhaG.S.,―ManagementandEntrepreneurshipDevelopment‖,IndusValleyPublicatio n, 2009.
3. BadiV.,BadiN.V.,―BusinessEthics‖,R.VrindaPublication(P)Ltd.,edition-2 2014.
4. PrasannaChandra,―Projects-Planning,Analysis,Financing,Implementationand review, TATA McGraw Hill, 2017.

RAE28-DISASTERMANAGEMENT   4   0   0   4

COURSEOBJECTIVES
- Toprovidestudentsanexposuretodisasters,theirsignificanceandtypes.
- Toensurethatstudentsbegintounderstandtherelationshipbetweenvulnerability, disasters, disaster prevention and risk reduction
- Togaina preliminaryunderstandingofapproachesofDisasterRiskReduction(DRR)
- Toenhanceawarenessofinstitutionalprocessesinthecountryand
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

COURSEOUTCOMES
- Differentiatethetypesofdisasters,causesandtheirimpactonenvironmentandsociety
- Assessvulnerabilityandvariousmethodsofriskreductionmeasuresaswellas mitigation.
- DrawthehazardandvulnerabilityprofileofIndia,ScenariosintheIndiancontext, Disaster damage assessment and management.
- Abilitytoanalysesandsolvedisasterissue usingcase studyapproach

UNITI:INTRODUCTIONTODISASTERS
Definition:Disaster,Hazard,Vulnerability,Resilience,Risks–Disasters:Typesofdisasters
– Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impactsincluding social, economic, political, environmental, health, psychosocial, etc.- Differential impacts-in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don‘ts during various types of Disasters. **(12)**

UNITII:APPROACHESTODISASTERRISKREDUCTION(DRR)
 Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of-community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders - Institutional Processessand Framework at State and Central Level-State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies. **(12)**

UNITIII:INTER-RELATIONSHIPBETWEENDISASTERSAND
        DEVELOPMENT
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources. **(12)**

UNITIV:DISASTERRISKMANAGEMENTININDIA
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment **(12)**

UNIT V: DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

(12)

TEXTBOOKS:
1. Singhal J.P. —Disaster Management‖, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. TusharBhattacharya,—DisasterScienceandManagement‖,McGrawHillIndia Education Pvt. Ltd., 2017. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. GuptaAnilK,SreejaS.Nair.EnvironmentalKnowledgeforDisasterRiskManagement, NIDM, New Delhi, 2011
4. KapurAnuVulnerableIndia:AGeographicalStudyofDisasters,IIASandSage Publishers, New Delhi, 2010.

REFERENCE BOOKS:
1. Govt.ofIndia:DisasterManagementAct,GovernmentofIndia,NewDelhi,2005
2. GovernmentofIndia,NationalDisasterManagementPolicy,2009.

RAE29TOTALQUALITYMANAGEMENT   4   0   0   4

COURSEOBJECTIVES
- TofacilitatetheunderstandingofQualityManagementprinciplesandprocess.

COURSEOUTCOMES
- The student would beable toapplythe tools and techniques ofqualitymanagementto manufacturing and services processes.
- Abilitytorememberthe basicsof quality
- Abilityto applyTQMtoolsand techniquesto resolvequalityproblems
- Abilityto demonstratequalitymanagementsystem

UNITI:INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.   (12)

UNIT II :TQM PRINCIPLES

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.   **(12)**

UNIT III: TQM TOOLS AND TECHNIQUES - I

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.   **(12)**

UNITIV:TQM TOOLSANDTECHNIQUES-II

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi qualityloss function - TPM - Concepts, improvement needs - Performance measures.   **(12)**

UNITV:QUALITYMANAGEMENTSYSTEM

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation— Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT **SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001— Requirements of ISO 14001—Benefits of EMS**.**   **(12)**

TEXT BOOK:
1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, —Total Quality Management‖, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:
1. James R.Evans and William M. Lindsay, "The Management and Control ofQuality", 8th Edition, First Indian Edition, Cengage Learning, 2011.
2. B.JanakiramanandGopal.R.K.,"TotalQualityManagement-TextandCases", Prentice Hall (India) Pvt. Ltd., 2009.
3. Suganthi.LandAnandSamuel,"TotalQuality Management",PrenticeHall(India) Learning 7ᵗʰ print,Pvt. Ltd., 2011.
4. ISO9001-2015 QualityManagement Systems.

RAE30SUPPLYCHAINMANAGEMENT   4   0   0   4

COURSEOBJECTIVES
- ➢ Toprovideaninsightonthefundamentalsofsupplychainnetworks,toolsandtechniques.

COURSEOUTCOMES
- ➢ The studentwould understandthe framework and scope of supplychain networks and functions.
- ➢ Torecalltherole,scopeanddecisionphasesofsupplychain.
- ➢ Toidentifythe factors,optionofdistributionnetworkdesign.
- ➢ Toanalyse the rolesandfactorsoftransportationdecisionandnetwork.
- ➢ Toexplorethe roleofgoverningand coordinationin supplychain.
- ➢ Toidentifytheroleof ITin supplychain.

UNITI:INTRODUCTION
Role of Logistics and Supply chain Management: Scope and Importance- Evolution ofSupplyChain -Decision Phases in SupplyChain – Competitive and Supplychain Strategies – Drivers of Supply Chain Performance and Obstacles. **(12)**

UNITII:SUPPLYCHAINNETWORKDESIGN
Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions. **(12)**

UNITIII:LOGISTICS INSUPPLYCHAIN
Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation**.** **(12)**

UNIT IV: SOURCING AND COORDINATION IN SUPPLY CHAIN
Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration – sourcing planning and analysis – supply chain co ordination – Bull whipeffect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain. **(12)**

UNIT V : SUPPLY CHAIN AND INFORMATION TECHNOLOGY
TheroleITinsupplychain-ThesupplychainITframeworkCustomerRelationship Management– Internalsupplychainmanagement–supplierrelationshipmanagement– future of IT in supply chain –E-Business in supply chain**.** **(12)**

TEXT BOOK :
1. SunilChopra,PeterMeindlandKalra,―SupplyChainManagement,Strategy, Planning, and operation‖, Pearson Education, 6th edition, 2016.

REFERENCEBOOK:
1. JeremyF.Shapiro,―Modelingthesupplychain‖,ThomsonBrooks/cole,2007.
2. SrinivasanG.S,―QuantitativemodelsinOperationsandSupplyChainManagement‖, PHI, 2010.
3. DavidJ.Bloomberg,StephenLemayandJoeB.Hanna,―Logistics‖,PHI2002.
4. JamesB.Ayers,―HandbookofSupplychainmanagement‖,St.Luciepress,2001.