PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014

B.TECH

IN

MECHATRONICS ENGINEERING

Regulations, Curriculum and Syllabus

2019 - 2020 ONWARDS

BACHELOR OF TECHNOLOGY PROGRAMME

IN

MECHATRONICS ENGINEERING

(EIGHT SEMESTERS)

REGULATIONS

1. Conditions for Admission:

(a) Candidates for admission to the first semester of the eight 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 (40% marks 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 Council of the Pondicherry University as equivalent thereto.

(b) For Lateral entry in to third semester of the eight semester B.Tech Degree programme:

The minimum qualification for admission is a pass in three year diploma or four years sandwich diploma course in engineering / technology from an

AICTE approved institution with at least 45% marks (40% marks for OBC and SC/ST candidates) in aggregate in the subjects covered from 3rd to final semester or a pass in B.Sc. degree from a recognized university as defined by UGC with at least 45% marks (40% marks for OBC and SC/ST candidates) and passed XII standard with mathematics as one of the subject.

Provided that in case of students belonging to B.Sc. stream shall clear the subjects of Engineering Graphics and Engineering mechatronics of the first year Engineering program along with the second year subjects.

Provided further that, the students belonging to B.Sc. stream shall be considered only after filling the supernumerary seats in this category with students belonging to the Diploma stream.

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 year under consideration. For lateral entry admission to second year of degree programme, there is no age limit. For SC/ST candidates, age limit is relaxable by 3 years.

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 and Communication Engineering
Branch IV	**:**	Computer Science and Engineering
Branch V	**:**	Electrical and Electronics Engineering
Branch VI	**:**	Chemical Engineering
Branch VII	**:**	Electronics and Instrumentation Engineering
Branch VIII	**:**	Information Technology
Branch IX	**:**	Instrumentation and Control Engineering
Branch X	**:**	Biomedical Engineering
Branch XI	**:**	Mechatronics Engineering

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 examination 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 marks for 95% and above
4 marks for 90% and above but below 95%
3 marks for 85% and above but below 90%
2 marks for 80% and above but below 85%
1 mark for 75% and above but below 80%

In total, three tests are to be conducted and the better two are to be considered for assessment.

(b) Practical courses for which there is a university practical examination of 50 marks:

The internal assessment marks of 50 has to be distributed as 20 marks for the periodic practical works and records submitted thereof, 15 marks for an internal practical examination, 5 marks for an internal viva voce, and 10 marks for class attendance in the particular subject. The distribution of marks is as given below.

10 marks for 95% and above
8 marks for 90% and above but below 95%
6 marks for 85% and above but below 90%
4 marks for 80% and above but below 85%
2 marks for 75% and above but below 80%

8. Requirement for appearing for University Examination:

A candidate shall be permitted to appear for university examination at the end of any 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 pay a condonation fee as prescribed by University along with a medical certificate obtained from a medical officer not below the rank of Asst. Director).

(ii) He / She earn a progress certificate from the Head of the institution for having satisfactorily completed the course of study in all the subjects pertaining to 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 semester for students admitted under lateral entry).

10. Passing Minimum:

(a) 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.

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

1. 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.
2. The candidate should have attended all the college examinations as well as university examinations.
3. If a candidate has failed in more than two papers in the current university examination, his/her representation for revaluation will not be considered.
4. The request for revaluation must be made in the format prescribed and duly recommended by the Head of the Institution along with the revaluation fee prescribed by the university.
   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, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below:

Range of Total Marks	Letter Grade	Grade Points
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	

'F' denotes failure in the course. 'FA' denotes absent / detained as per clause 8.

After results are declared, grade sheets will be issued to the students. The grade sheets will contain the following details:

(a) The college in which the candidate has studied.
(b) The list of course enrolled during the semester and the grades scored.
(c) The Grade Point Average (GPA) for the semester and the cumulative Grade 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 grade points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses.

$$GPA = \text{Sum of } (C \times GP) / \text{Sum of Credit}$$

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. The conversion of CGPA into percentage marks is as given below.

$$MARKS = (CGPA - 0.5) \times 10$$

12. Award of Class and Rank:

1. A candidate who satisfies the course requirements for all semesters and who passes all the examinations prescribed for all the eight semesters (six semesters for lateral entry candidates) within a maximum period of 7 years (6 years for lateral entry candidates) 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.

2. A candidate who qualifies for the award of the degree passing in all subjects pertaining to semesters 3 to 8 in his/her first appearance within 6 consecutive semesters (3 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 8 shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION**

3. 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 secures CGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS.**

4. All other candidates who qualify for the award of degree shall be declared to have passed the examination in **SECOND CLASS.**

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

13. Provision for withdrawal:

A candidate may, for valid reasons, and on the recommendation of the Head of the Institution, be granted permission by the University to withdraw from writing the entire semester examination as one Unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to 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. Discontinuation of course:

If a candidate wishes to temporarily discontinue the course for valid reasons, he/she hall 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 re-join 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 was admitted shall not in any case, exceed 7 years, including of the period of discontinuance.

15. Revision of Regulations and Curriculum:

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

ANNEXURE-A

B.Tech courses in which admission is sought	Diploma courses eligible for admission
Civil Engineering	Civil Engineering Civil and Rural Engineering Architectural Assistantship Architecture Agricultural Engineering
Mechanical Engineering	Mechanical Engineering Automobile Engineering Agricultural Engineering Mechanical and Rural Engineering Refrigeration and Air-conditioning Agricultural Engineering & Farm Equipment Technology Metallurgy Production Engineering Machine Design & Drafting Machine Tool Maintenance and Repairs Printing Technology / Engineering Textile Engineering / Technology Tool Engineering Mechatronics Plastics and Moulding Technology
Electrical and electronics Engineering **Electronics & communication Engineering** **Electronic and instrumentation Engineering** **Instrumentation and control Engineering** **Bio Medical Engineering**	Electrical Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Instrumentation Engineering / Technology Electronics and Communication Engineering Electronics Engineering Medical Electronics Instrumentation and Control Engineering Applied Electronics
Chemical Engineering	Chemical Engineering Chemical Technology Petrochemical Technology Petroleum Engineering Ceramic Technology Plastic Engineering Paper & pulp Technology/Polymer Technology

Information Technology **Computer Science & Engineering**	Computer Science and Engineering Computer Technology Electrical and Electronics Engineering Electronics & Communication Engineering Electronics & Instrumentation Engineering Instrumentation Engineering / Technology Information Technology
Mechatronics Engineering	Mechanical Engineering Automobile Engineering Production Engineering Machine Design & Drafting Machine Tool Maintenance and Repairs Printing Technology / Engineering Mechatronics Plastics and Moulding Technology Electrical and Electronics Engineering Electronics and Communication Engineering Electronics and Instrumentation Engineering Instrumentation and Control Engineering

CURRICULUM

B.Tech - (MECHATRONICS ENGINEERING)

I Semester

S. No.	Subject Code	Subject	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
1	T101	Mathematics – I	3	1	0	4	25	75	100
2	T102	Physics	4	0	0	4	25	75	100
3	T103	Chemistry	4	0	0	4	25	75	100
4	T104	Basic Electrical and Electronics Engineering	3	1	0	4	25	75	100
5	T105	Engineering Thermodynamics	3	1	0	4	25	75	100
6	T106	Computer Programming	3	1	0	4	25	75	100
Practical									
7	P101	Computer Programming Lab	0	0	3	2	50	50	100
8	P102	Engineering Graphics	2	0	3	2	50	50	100
9	P103	Basic Electrical and Electronics Lab	0	0	3	2	50	50	100
Total			**22**	**04**	**09**	**30**	**300**	**600**	**900**

II Semester

S. No.	Subject Code	Subject	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
1	T107	Mathematics – II	3	1	0	4	25	75	100
2	T108	Material science	4	0	0	4	25	75	100
3	T109	Environmental science	4	0	0	4	25	75	100
4	T110	Basic Civil and Mechanical Engineering	4	0	0	4	25	75	100
5	T111	Engineering Mechanics	3	1	0	4	25	75	100
6	T112	Communicative English	4	0	0	4	25	75	100
Practical									
7	P104	Physics Lab	0	0	3	2	50	50	100
8	P105	Chemistry Lab	0	0	3	2	50	50	100
9	P106	Workshop Practice	0	0	3	2	50	50	100
10	P107	NSS / NCC	-	-	-	-	-	-	-
Total			**22**	**2**	**9**	**30**	**300**	**600**	**900**

∗ *I and II Semester Curriculum Common to all Branches- Existing Syllabus*

III Semester

S. No.	Subject Code	Subject	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
1	MAT31	Analytic functions and Partial Differential Equations	3	1	0	4	25	75	100
2	MTT31	Strength of Materials	3	1	0	4	25	75	100
3	MTT32	Fluid Mechanics and Machinery	3	1	0	4	25	75	100
4	MTT33	Analog Circuits Design	3	1	0	4	25	75	100
5	MTT34	Electrical Machines	3	1	0	4	25	75	100
6	MTT 35	Digital Circuits Design	4	0	0	4	25	75	100
Practical									
7	MTP31	Strength of Materials and Fluid Mechanics and Machinery Lab	0	0	3	2	50	50	100
8	MTP32	Electrical Machines Lab	0	0	3	2	50	50	100
9	MTP33	Analog and Digital Circuits Lab	0	0	3	2	50	50	100
Total			**19**	**05**	**09**	**30**	**300**	**600**	**900**

IV Semester

S. No.	Subject Code	Subject	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
1	MAT41	Statistics and Numerical Methods	3	1	0	4	25	75	100
2	MTT41	Mechanics of Machines - I	3	1	0	4	25	75	100
3	MTT42	Thermal Engineering and Heat Transfer	3	1	0	4	25	75	100
4	MTT43	Manufacturing Technology	4	0	0	4	25	75	100
5	MTT44	Sensors, Transducers and Measurement system	4	0	0	4	25	75	100
6	MTT45	Power Electronics and Drives	4	0	0	4	25	75	100
Practical									
7	MTP41	Sensors, Transducers and Measurement Lab	0	0	3	2	50	50	100
8	MTP42	Manufacturing Technology Lab	0	0	3	2	50	50	100
9	MTP43	Computer Aided Drafting Lab	0	0	3	2	50	50	100
Total			**21**	**03**	**09**	**30**	**300**	**600**	**900**

V Semester

S. No.	Subject Code	Subject	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
1	MTT51	Mechanics of Machines - II	3	1	0	4	25	75	100
2	MTT52	Programming for Automation using Python	4	0	0	4	25	75	100
3	MTT53	CNC and Metrology	4	0	0	4	25	75	100
4	MTT54	Microprocessor and Microcontroller Applications	4	0	0	4	25	75	100
5	MTT55	Control System for Mechatronics	3	1	0	4	25	75	100
6	MTE	Elective- I	3	0	0	3	25	75	100
Practical									
7	MTP51	Programming for Automation Lab	0	0	3	2	50	50	100
8	MTP52	CNC and Metrology Lab	0	0	3	2	50	50	100
9	MTP53	Microprocessor and Microcontroller Lab	0	0	3	2	50	50	100
10	MTP54	General Proficiency - I	0	0	3	1	100	-	100
Total			**21**	**2**	**12**	**30**	**400**	**600**	**1000**

VI Semester

S. No.	Subject Code	Subject	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
1	MTT61	Design of Mechanical Elements	3	1	0	4	25	75	100
2	MTT62	Fluid Power System	3	1	0	4	25	75	100
3	MTT63	Industrial Robotics	4	0	0	4	25	75	100
4	MTT64	Industrial Automation	4	0	0	4	25	75	100
5	MTT65	Design of Mechatronics System	3	1	0	4	25	75	100
6	MTE	Elective - II	3	0	0	3	25	75	100
Practical									
7	MTP61	Virtual Instrumentation Lab	0	0	3	2	50	50	100
8	MTP62	Industrial Automation Lab	0	0	3	2	50	50	100
9	MTP63	Fluid Power System Lab	0	0	3	2	50	50	100
10	MTP64	General Proficiency - II	0	0	3	1	100	-	100
Total			**20**	**3**	**12**	**30**	**400**	**600**	**1000**

VII Semester

S. No.	Subject Code	Subject	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
1	MTT71	Engineering Economics and Management	4	0	0	4	25	75	100
2	MTT72	Embedded System Design	4	0	0	4	25	75	100
3	MTE	Elective - III	3	0	0	3	25	75	100
4	MTE	Elective - IV	3	0	0	3	25	75	100
Practical									
5	MTP71	Computer Aided Engineering Lab	0	0	3	2	50	50	100
6	MTP72	Embedded System Design Lab	0	0	3	2	50	50	100
7	MTP73	Project Phase I	0	0	3	4	50	50	100
8	MTP74	Industrial Visit / Training Report	-	-	-	1	100	-	100
9	MTP75	Comprehensive Viva Voce	0	0	3	1	50	50	100
Total			**14**	**0**	**12**	**24**	**400**	**500**	**900**

VIII Semester

S. No.	Subject Code	Subject	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
1	MTT81	Automotive Electronics	4	0	0	4	25	75	100
2	MTT82	Professional Ethics and Indian Constitution	1	0	0	1	100	-	100
3	MTE	Elective - V	3	0	0	3	25	75	100
4	MTE	Elective - VI	3	0	0	3	25	75	100
Practical									
5	MTP81	Project Phase II	0	0	12	8	50	50	100
6	MTP82	Seminar	0	0	3	1	100	-	100
Total			**11**	**0**	**15**	**20**	**325**	**275**	**600**

List of Electives

S.No.	Course Code	Course Title	Category
Semester V		**Elective - I**	
1	MTE51	Automobile Engineering	E
2	MTE52	Total Quality Management	E
3	MTE53	Unconventional Machining Process	E
4	MTE54	Introduction to Finite Element Analysis	E
5	MTE55	Smart materials for Mechatronics	E
Semester VI		**Elective - II**	
1	MTE61	Additive Manufacturing	E
2	MTE62	MEMS and Nano Technology	E
3	MTE63	Biomedical Instrumentation	E
4	MTE64	Instrumentation Automotive Industries	E
5	MTE65	Internet of Things (IoT)	E
Semester VII		**Elective – III**	
1	MTE71	Process Planning and Cost Estimation	E
2	MTE72	Artificial Intelligence and Machine Learning	E
3	MTE73	Virtual Instrumentation	E
4	MTE74	Automated Material Handling	E
5	MTE75	Intelligent Control System	E
		Elective – IV	
6	MTE76	Avionics	E
7	MTE77	Quality control and Reliability	E
8	MTE78	Digital Image Processing and Machine Vision	E
9	MTE79	Autonomous Mobile Robots	E
10	MTE710	Product Design and Development	E
Semester VIII		**Elective – V**	
1	MTE81	Non-Destructive Testing Methods	E
2	MTE82	Maintenance Engineering and Conditioning Monitoring	E
3	MTE83	Modern Sensors and Networking	E
4	MTE84	Industrial Electronic and Applications	E
5	MTE85	Cyber Physical System	E
		Elective –VI	
6	MTE86	Data Communication and Networking	E
7	MTE87	Non-Conventional Energy Sources	E
8	MTE88	Composite Materials and Structures	E
9	MTE89	Entrepreneurship Development	E
10	MTE810	Automated Instrumentation and Embedded systems	E

T101	MATHEMATICS – I	L	T	P	C	Hours
		3	1	0	4	60

Objectives:

- To introduce the idea of applying calculus concepts to problems in engineering
- To familiarize the student with functions of several variables.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To introduce effective mathematical tools for the solutions of differential equations that model physical processes

Outcomes:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental
- Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.

Unit I Calculus **(12 Hours)**

Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.

Unit II Functions of several variables **(12 Hours)**

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.

Unit III Multiple integrals and applications **(12 Hours)**

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).

Unit IV Differential equations **(12 Hours)**

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

Unit V Differential Equations (Higher Order) **(12 Hours)**

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 application to electric circuits.

Text Books

1. Venkatraman M.K, Engineering Mathematics – First year, National publishing company, Chennai, 2010.(For Units I,III,IV &V only)
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011. (For Unit II only)

References

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Kandasamy P. et al, Engineering Mathematics, Vol.1 & 2,S. Chand & Co., New Delhi.
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & sons, New Delhi, 8th Edition.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
5. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

T102	PHYSICS	L	T	P	C	Hours
		4	0	0	4	60

Objectives:

- To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transformed modern-day society.
- To expose the students to different areas of physics which have direct relevance and applications to different Engineering disciplines.
- To understand the concepts and applications of Ultrasonic, optics and some optical devices, Laser and Fiber optics, Nuclear energy sources and wave mechanics.

Outcomes:

- The students will gain knowledge on the basics of properties of matter and its applications.
- The students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
- The students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
- The students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes.
- The students will get knowledge on nuclear energy.

Unit I Acoustics & NDT **(12 Hours)**

Ultrasonic's – Ultrasonic Waves productions (piezoelectric & Magnetostriction method) - Detections (Acoustic Grating) NDT applications – Ultrasonic pulse 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 applications to Radars. (elementary ideas)

Unit II Optics **(12 Hours)**

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 Wave Plates – Specific Rotary Power – Laurent Half Shade Polari meter

Unit III Lasers & Fiber Optics **(12 Hours)**

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, CO2 laser, GaAs Laser-applications 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) – applications to sensors and Fiber Optics Communication

Unit IV Wave Mechanics **(12 Hours)**

Matter Waves – de Broglie Wavelength – Uncertainty Principle – Schrodinger Wave Equation – Time Dependent – Time Independent – Application to Particle in a One Dimensional Potential Box – Quantum Mechanical Tunneling – Tunnel Diode

Unit V Nuclear Energy Source **(12 Hours)**

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 reactors - D-D and D-T reactions, Basic principles of Nuclear fusion reactors.

Text Books

1. V Rajendran, Engineering Physics, 2nd Edition TMH, New Delhi 2011 (For Units I to IV only)
2. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi reprinted 2008. (For Unit V only)

References

1. Ajay Ghatak, Optics, 5th Edition TMH, New Delhi, 2012.
2. K. Thyagarajan and AjoyGhatak, Laser Fundamentals and Applications, 2nd Edition, Springer 2010.
3. R. Murugesan, Modern Physics, S. Chand & Co, New Delhi 2006.
4. K.R.Nambiar, Laser, New Age International, New Delhi, 2008.
5. Science of Engineering Materials, 2nd Edition, C.M. Srivastava and C. Srinivasan, New Age Int. (P) Ltd, New Delhi, 1997.
6. Avadhanulu M N, Engineering Physics, Vol-1, S. Chand & Co, 2009.

T103	CHEMISTRY	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To know about the importance of Chemistry in Engineering domain To understand the chemistry background of industrial process • To apply chemistry knowledge for Engineering disciplines					
Outcomes:	• The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.					

Unit I Water **(12 Hours)**

Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water-EDTA method. Disadvantages of hard water-boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softening method – internal & external conditioning – lime-soda process, zeolite process and ion exchange process. Desalination – reverse osmosis &electro dialysis.

Unit II Polymers **(12 Hours)**

Classification, types of polymerization reactions – mechanism of radical, ionic and Ziegler-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, rubber – vulcanization, synthetic rubber, BuNa-S, BuNa-N, Silicone and butyl rubber. Conducting Polymers – classification and applications. Polymer composites – FRP – laminar composites. Moulding constituents of plastics, moulding techniques – compression, injection, transfer and extrusion moulding.

Unit III Electrochemical Cells **(12 Hours)**

Galvanic cell, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes - hydrogen, calomel, Ag/AgCl & glass electrodes. Batteries - primary and secondary cells, Leclanche cell, Lead acid storage cell, Ni-Cd battery & alkaline battery. Fuel cells – H_2-O_2 fuel cell.

Unit IV Corrosion and its Control **(12 Hours)**

Chemical & electrochemical corrosion-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.

Unit V Phase Rule **(12 Hours)**

Definition and derivation of phase rule. Application to one component system - water and Sulphur systems. Thermal analysis, condensed phase rule. Two component systems – Pb - Ag, Cu-Ni and Mg-Zn systems.

Text Books

1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai and Sons, New Delhi 15th Ed, 2010

References

1. S. S. Dara, A Textbook of Engineering Chemistry, 11th Ed, S. Chand & Co., Ltd. New Delhi, 2008.
2. B. K. Sharma, Engineering Chemistry, 3rd edition Krishna Prakashan Media (P) Ltd., Meerut, 2001.
3. P. Kannan and A. Ravi Krishnan "Engineering Chemistry"
4. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 2nd Ed, PHI Learning PVT., LTD, New Delhi, 2008.
5. Hi-Tech Sri Krishna Publications, Chennai, 9th Ed, 2009.

T104	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C	Hours
		3	1	0	4	60
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 flip flops. • To gain knowledge on various communication systems and network models and the use of ISDN					
Outcomes:	• Understand electric circuits and working principles of electrical machines • Understand the concepts of various electronic devices • Choose appropriate instruments for electrical measurement for a specific application					

PART A – ELECTRICAL

Unit I DC Circuits **(10 Hours)**

Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law, Kirchhoff'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.

Unit II AC Circuits **(10 Hours)**

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

Unit III Electrical Machines and Power Plants **(10 Hours)**

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

PART B – ELECTRONICS

Unit IV Electronic Circuits **(10 Hours)**

V-I 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.

Unit V Digital Electronics **(10 Hours)**

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.

UNIT VI Communication and Computer Systems **(10 Hours)**

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.

Text Books

1. Kothari D P and Nagrath I J, Basic Electrical Engineering, Tata McGraw Hill, 2009. (For Units I to III)
2. Rajendra Prasad , "Fundamentals of Electronic Engineering", Cengage learning, New Delhi, first Edition, 2011 (For Unit IV)
3. Morris Mano, "Digital Design", PHI learning, Fourth Edition, 2008 (For Unit V)
4. Wayne Tomasi, "Electronic Communication Systems-Fundamentals Theory Advanced", Sixth Edition, Pearson Education, 2004.(For Unit VI)

References

1. R. Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004.
2. J.B.Gupta, A Course in Electrical Power, Katson Publishing House, 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 GoutamSaha, "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, DhanpatRai& 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	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To understand the basics of the thermodynamic principles • To establish the relationship of these principles to thermal system behaviors To develop methodologies for predicting the system behavior • To establish the importance of laws of thermodynamics applied to energy systems • To explain the role of refrigeration and heat pump as energy systems • To develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world					
Outcomes:	• Express the laws and basic concept of thermodynamics • Draw PV diagram and obtain the performance of air standard cycles • Carry one dimensional heat transfer through conduction for a given system • Explain the types of convection and determine heat transfer coefficient • Compute the radiation effect among different surfaces					

Unit I Basic Concepts And Definitions **(12 Hours)**

Energy conversion and efficiencies - system, property and state – Thermal equilibrium – Temperature – Zeroth law of Thermodynamics – Pure substance – P, V and T diagrams – Thermodynamic diagrams.

Unit II First Law of Thermodynamics **(12 Hours)**

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

Unit III Second Law of Thermodynamics **(12 Hours)**

Equilibrium and the second law – Heat engines – Kelvin-Plank statement of second law of thermodynamics – Reversible and irreversible processes – Carnot principle – Clausius inequality – Entropy

Unit IV Gas Power Cycles **(12 Hours)**

Air standard cycles: The air standard carnot cycle – Air standard Otto cycle, Diesel cycle, Dual cycle and Brayton cycles and their efficiencies

Unit V Refrigeration Cycles and Systems **(12 Hours)**

Reverse Carnot cycle – COP – Vapor compression refrigeration cycle and systems (only theory) – Gas refrigeration cycle – Absorption refrigeration system – Liquefaction – Solidification (only theory).

Text Books

1. Nag, P.K., "Engineering Thermodynamics", 4th edition, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2008.

References

1. Arora, C.P., “Thermodynamics”, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2010.
2. Burghardt, M.D., “Engineering Thermodynamics with Applications”, 4th edition, Harper & Row, N.Y., 2009.
3. Huang, F.F., “Engineering Thermodynamics” 2nd edition, Macmillan Publishing Co. Ltd., N.Y., 2011.
4. Cengel, Y.A. and Boles, M.A., “Thermodynamics – An Engineering approach”, 5th edition, McGraw Hill, 2008.
5. Wark, K., “Thermodynamics”, 4th edition Mc-Graw Hill, N.Y., 2009.

T106	COMPUTER PROGRAMMING	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To introduce the basics of computers and information technology. To educate problem solving techniques. • To impart programming skills in C language. • To practice structured programming to solve real life problems.					
Outcomes:	• Recognize the basic concepts of computers. • Implement programs using operators and expressions. • Demonstrate the usage of control structures. • Execute programs using Arrays and strings. • Summarize the concepts of structures and functions.					

Unit I **(12 Hours)**

History of computers – Block diagram of a computer – Components of a computer system – Classification of computers – Hardware – Software – Categories of Software – Operating System – Applications of Computers – Network structure – Internet and its services – Intranet – Study of word processor – Preparation of worksheets.

Unit II **(12 Hours)**

Problem solving techniques – Program – Program development cycle – Algorithm design – Flowchart – Pseudo code.

Introduction to C – History of C – Importance of C – C tokens – Data types – Operators and expressions – I/O functions.

Unit III **(12 Hours)**

Decision making statements – branching and looping – arrays – multidimensional arrays – Functions – Recursion – Passing array to functions. Storage classes – Strings – String library functions.

Unit IV **(12 Hours)**

Structures – Arrays and structures – nested structures – passing structures to functions – user defined date types – Union.

Pointers – pointers and arrays – pointers and functions – pointer and strings – pointer and structures.

Unit V **(12 Hours)**

Files – operations on a file – Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

Text Books

1. Balagurusamy. E, “Programming in ANSI C”, Tata Mc-Graw Hill, sixth edition, 2012.

References

1. Vikasverma, “A Workbook on C”, Cengage Learning, Second Edition, 2012.
2. Ashok N Kamthane, “Computer Programming”, Pearson education, second Impression, 2008.

P101	COMPUTER PROGRAMMING LAB	L	T	P	C
		0	0	3	2
Objectives:	• To study and understand the use of OS commands • To gain a hands on experience of compilation and execution of 'C' programs				

List of Experiments

1. Study of OS Commands
2. Write a C program to find the area of Triangle.
3. Write a C program to find the total and average percentage obtained by a student of 6 subjects.
4. Write a C program to read a three digit number and produce output like

   1 hundreds

   7 tens

   2 units for an input of 172.
5. Write a C program to check whether a given character is vowel or not using switch – Case statement.
6. Write a C program to print the number from 1 to 10 along with their squares.
7. Write a C program to find the sum of 'n' numbers using for, do – while statements.
8. Write a C program to find the factorial of a given number using Functions.
9. Write a C program to swap two numbers using call by value and call by reference.
10. Write a C program to find the smallest and largest element in an array.
11. Write a C program to perform matrix multiplication.
12. Write a C program to demonstrate the usage of local and Global variables.
13. Write a C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a C program to remove all characters in a string except alphabets.
15. Write a C program to find the sum of an integer array using pointers.
16. Write a C program to find the Maximum element in an integer array using pointers.
17. Write a C program to create student details using Structures.
18. Write a C program to display the contents of the file on the monitor screen.
19. Create a file by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a C program to pass the parameter using command line arguments.

P102	ENGINEERING GRAPHICS	L	T	P	C
		2	0	3	2
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 mode in drawing that are used in real systems • To explain the role of computer aided design_ Auto Cad • To develop an intuitive understanding of underlying significance of using these drawings				
Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning					
UNIT I Conic sections, Involutes, Spirals, Helix. Projection of Points, Lines and planes					
UNIT II 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. K.R. Gopalakrishna and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.					
Reference Books: 1. N.D. Bhatt, Engineering Drawing, 49th edition, Chorotar Publishing House, 2006. 2. K. Venugopal, Engineering Drawing and Graphics + Auto CAD, 4th edition, New Age International Publication Ltd., 2004. 3. David I cook and Robert N Mc Dougal, 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. K.V. Natarajan, A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.					

P103	BASIC ELECTRICAL AND ELECTRONIC LAB	L	T	P	C
		0	0	3	2
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 junctions diode and transistor • To gain a practical knowledge on the functions and applications 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. Bed room wiring
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuit's 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 Kirchhoff' s Voltage and Current Laws

Determine the voltage and current in given circuits using Kirchhoff'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 Half wave 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, EXNOR gates and flip-flops – JK, RS, T and D

c) Implementation of digital functions using logic gates and universal gates.

T107	MATHEMATICS – II	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To develop the use of matrix algebra techniques for practical applications. • 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.					
Outcomes:	• Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices. • Gradient, divergence and curl of a vector point function and related identities. • Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification. • Analytic functions, conformal mapping and complex integration. • Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.					

Unit I Matrices **(12 Hours)**

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 quadratic forms.

Unit II Vector Calculus **(12 Hours)**

Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke's theorem (without proof). Simple application problems

Unit III Laplace Transform **(12 Hours)**

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

Unit IV Applications of Laplace Transform **(12 Hours)**

Methods for determining inverse Laplace transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integral by Laplace transforms.

Unit V Fourier Transform **(12 Hours)**

Fourier integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, convolution and Parseval's identity.

Text Books

1. Venkataraman. M. K., Engineering Mathematics, National Publishing Company, Chennai, 2012.
2. Kandasamy P. et al, Engineering Mathematics, vol.2 & 3, S. Chand & Co., New Delhi.

References

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.
5. Bali N. &Goyal M. Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

T108	MATERIAL SCIENCE	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To understand the importance of material science as a subject that revolutionized 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.					
Outcomes:	• Gained knowledge about crystal structures and lattice defects. • Gained knowledge about polarization. • Know about magnetic moment of dia, para, ferro materials. • Gained knowledge about semi and super conductors. • Know about advanced materials like liquid crystals, Nano materials.					

Unit I Crystal Structure And Lattice Defects **(12 Hours)**

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

Unit II Dielectric Properties **(12 Hours**

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 Piezo electrics, Ferroelectrics and Pyroelectric materials and Applications

Unit III Magnetic Properties **(12 Hours)**

Origin of atomic magnetic moment – Bohr magneton - Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theory of 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

Unit IV Semiconductors And Superconductors **(12 Hours)**

Semiconductors- Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of electrical conductivity in intrinsic and extrinsic semiconductors (without derivation) - temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in semiconductors - Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V)

Superconductivity - Basic concepts – transition temperature – Meissener effect –Type I and II superconductors – high temperature superconductors – 123 superconductor- applications of superconductors.

Unit V Advanced Materials **(12 Hours)**

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 non-material's. Carbon nanotubes- synthesis, Properties and applications.

Text Books

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011

References

1. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009.
2. William D Callister Jr., Material Science and Engineering, 6th Edition, John Wiley and sons, 2009.
3. Charles Kittel, Introduction to Solid State Physics, 7th edition, John Wiley and sons, Singapore, 2007.
4. V Raghavan, Materials Science and Engineering- A First Course, 5th edition Prentice Hall of India, 2008.
5. B.S Murthy, P. Shankar, Baldev Raj, B.B.Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012.
6. M.N. Avadhanulu, Engineering Physics- Volume-II, S.Chand&Co, New Delhi, 2009
7. Pillai S.O, Solid State Physics, 6TH Edition- New Age International, 2005.

T109	ENVIRONMENTAL SCIENCE	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To know about the environment. • To understand about environmental pollution. • To apply the knowledge in understanding various environmental issues and problems.					
Outcomes:	• Demonstrate the importance of interdisciplinary nature of environment, its purpose, design and exploitation of natural resources. • Analyze the fundamental physical and biological principles that govern natural processes and role of professionals in protecting the environment from degradation. • Apprehend the existing environmental challenges related to pollution and its management. • Evaluate strategies, technologies and methods for sustainable management of environmental systems. • Characterize and analyze human impacts on the environment.					

Unit I Environment and Energy Resources **(12 Hours)**

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.

Unit II Ecosystem and Biodiversity **(12 Hours)**

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, estuarine and marine) ecosystem. 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.

Unit III Air Pollution **(12 Hours)**

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.

Unit IV Water and Land Pollution **(12 Hours)**

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.

Unit V Pollution Control and Monitoring (12 Hours)

Basic concepts and instrumentation of IR, UV-VIS, atomic absorption spectrometry, Gas Chromatography and Conductometry. Analysis of air pollutants – NOX, COX, SOX, H2S, Hydrocarbons and particulates.

Text Books

1. K. Raghavan Nambiar, "Text Book of Environmental studies" 2nd Ed, Scitech Publications (India) Pvt Ltd, India, 2010 (For Units I & II)
2. A. K. De, "Environmental Chemistry" 7th Ed; New age International (p) Ltd, New Delhi, 2010.(For Units III,IV&V)

References

1. B.K. Sharma, "Environmental chemistry" 11th Ed, KRISHNA Prakashan Media (P) Ltd, Meerut, 2007.
2. S.S. Dara, and D.D. Mishra "A text book of environmental chemistry and pollution control, 5th Ed, S.Chand and Company Ltd, New Delhi, 2012.
3. Richard T. Wright, Environmental Science: Toward a sustainable future, 10th edition, Prentice Hall, 2008.
4. G.S. Sodhi, Fundamental concepts of environmental chemistry, I Ed, Alpha Science International Ltd, India, 2000.

T110	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To be able to differentiate the type of buildings according to national building code. • To 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 • To develop an intuitive understanding of underlying working principles of mechanical machines and systems.					
Outcomes:	• Understand the fundamental philosophy of Civil Engineering. • Identify the nature of building components, functions, construction practices and material qualities • Understand the fundamental concepts of water supply and transportation systems. • Recognize the various engineering materials and understand the working principles and operations of manufacturing processes. • Understand the working principles and operations of Internal Combustion Engines, Refrigeration, Boiler and power plants.					

PART –A CIVIL ENGINEERING

Unit I Buildings, Building Materials **(10 Hours)**

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.

Unit II Buildings and their components **(10 Hours)**

Various Components and their functions. Soils and their classification.
Foundation: function and types. Masonry-function and types. Floors: definition and types of floors. **Roofs**: definition and types.

Unit III Basic Infrastructure **(10 Hours)**

Surveying: Classification, general principles, types, Uses, instruments used. Roads-types: components, types and their advantage and disadvantages. Bridges: components and types of bridges. Dams: purpose, types of dams. Water supply-sources and quality requirements, need and principles of rainwater harvesting.

PART- B MECHANICAL ENGINEERING

Unit IV Internal And External Combustion Systems **(10 Hours)**

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 only low pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.

Unit V Power Generation Systems **(10 Hours)**

Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear Power plants – Schemes and layouts (Description only) Solar – Wind – Geothermal – Wave – Tidal and Ocean Thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only).

UNIT VI Manufacturing Process **(10 Hours)**

Machines – Lathe – Drilling – Bending – Grinding – Shearing (Description only) Machine Process – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filling – Sawing – Grinding. Moulding and Metal Joining – Pattern making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only).

Text Books

1. Natarajan, K V, Basic Civil Engineering, 11th edition, Dhanalakshmi publications Chennai, 2011. (For Units I to III)
2. Venugopal , K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012 (For Units IV to VI)

References

1. PurushothamaRaj.P., Basic civil engineering, 3rdEdn., Dhanam Publications, Chennai, 2001
2. Rajput, R K, Engineering Materials, S Chand & Co. Ltd., New delhi, 2012.
3. Punmia, B.C., et. al., surveying, Vol-1, Laxmi publishers, New Delhi, 2012.
4. Punmia, B.C., et. al., Building Construction, Laxmi publishers, New Delhi, 2012
5. El. Wakil, M.M., Power Plant Technology, McGraw Hill Book Co., 1985.
6. HajraChoudhry, et. al., Workshop Technology Vol I and II, Media promoters publishers Pvt. Ltd., Bombay, 2004.
7. Lindberg, R.A. Process and Materials of Manufacture, PHI, 1999.
8. H.N.Gupta, R.C. Gupta and Arun Mittal, Manufacturing Process, New Age Publications, 2001.
9. Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.

T111	ENGINEERING MECHANICS	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• 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 • To understand the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation • To emphasis the concepts through solved examples					
Outcomes:	• Illustrate the vectorial and scalar representation of forces and moments. • Analyse the rigid body in equilibrium. • Evaluate the properties of surfaces and solids. • Calculate dynamic forces exerted in rigid body. • Determine the friction and the effects by the laws of friction.					

Unit I Fundamental of Mechanics **(12 Hours)**

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, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.

Unit II Practical Application of Force System **(12 Hours)**

Structural member: Definition, degree of freedom, concept of free body diagrams, 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.

Unit III Properties of Surfaces **(12 Hours)**

Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product of moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.

Unit IV Kinematics and Kinetics of Particles **(12 Hours)**

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.

Unit V Kinematics and Kinetics of Rigid Bodies **(12 Hours)**

Plane motion, absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum

Text Books

1. Rajesekaran S and Sankara Subramanian., G., Engineering Mechanics, Vikas Publishing House Private Ltd., 2012.

References

1. Palanichamy, M.S. Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw-Hill, 2011.
2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol.2 Dynamics, McGraw – Hill International Edition, 1997.
3. Bhavikatti,S.S and K.G. Rajashekarappa, Engineering Mechanics, New Age International (p) Ltd, New Delhi, 2010.

T112	COMMUNICATIVE ENGLISH	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To improve the LSWR skills of I 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					
Outcomes:	• Develop their fluency and language competency in English.					

Unit I Basic Communication Theory **(12 Hours)**

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

Unit II Comprehension And Analysis **(12 Hours)**

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.

Unit III Writing **(12 Hours)**

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.

Unit IV Business Writing/Correspondence **(12 Hours)**

Report writing – Memoranda – Notice – Instruction – Letters – Resumes – Job applications.

Unit V Oral Communication **(12 Hours)**

Basics of phonetics – presentation skills – Group discussions – Dialogue writing – Short Extempore – Debates-Role Plays – conversation Practice.

Text Books

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

References

1. Ashraf M.Rizve., Effective Technical Communication. Tata-McGraw Hill, 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., Everday Dialogues in English, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
5. Sethi, J and KamaleshSadanand., A Practical course in English Pronunciation, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

P104	PHYSICS LAB	L	T	P	C
		0	0	3	2
Objectives:	• To provide a practical understanding of some of the concepts learnt in the theory course on physics				

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,

1. 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

P105	CHEMISTRY LAB	L	T	P	C
		0	0	3	2
Objectives:	• To gain a practical knowledge of Engineering chemistry in relevance to Industrial applications				

List of Experiments (Any 10 Experiments)

1. Determination of dissolved oxygen in water.
2. Determination of total hardness of water by EDTA method.
3. Determination of carbonate and bicarbonate in water.
4. Estimation of chloride content in water.
5. Estimation of magnesium by EDTA.
6. Estimation of acetic acid in vinegar.
7. Estimation of ferrous by permanganometry.
8. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.
9. Estimation of available chlorine in bleaching powder.
10. Estimation of copper in copper sulphate solution.
11. Estimation of calcium by permanganometry.
12. Estimation of iron by colorimetry.

Demonstration Experiments (Any two of the following)

1. Determination of COD of water sample.
2. Determination of lead by conductometry.
3. Percentage composition of sugar solution by viscometry.

P106	WORKSHOP PRACTICE	L	T	P	C
		0	0	3	2
Objectives:	• To convey the basics of mechanical tools used in engineering • To establish hands on experience on the working tools • To develop basic joints and fittings using the hand tools • To establish the importance of joints and fitting in engineering applications • To explain the role of basic workshop in engineering • To develop an intuitive understanding of underlying physical mechanism used in mechanical machines				

S. No.	Trade	List of Exercises
1	Fitting	Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle.
2	Welding	Study of arc and gas welding equipment and tools – Edge preparation – Exercise on lap joint and V Butt joints – Demonstration of gas welding
3	Sheet metal work	Study of tools and Machineries – Exercise on simple products like Office tray and waste collection tray.
4	Carpentry	Study of tools and Machineries – Exercises on Lap joints and Mortise joints

List of Exercises

I - FITTING

1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II - WELDING

1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3. Single V butt welding (Arc)

III - SHEET METAL WORK

1. Study of tools and machineries
2. Frustum
3. Waste collection tray

IV - CARPENTRY

1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint.

P107	NCC / NSS	L	T	P	C
		0	0	0	0

NCC / NSS training is compulsory for all Undergraduate students

1. The above activities will include practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 45 hours.
4. The above activities will be monitored by the respective faculty in-charge and the first 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. Pass in this course is mandatory for the award of degree.

MAT31	ANALYTIC FUNCTIONS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To provide the concepts of functions of a complex variable, conformal mapping, complex integration, series expansion of complex functions, Harmonic analysis and Fourier series. • To introduce Fourier series analysis which is the central to many applications in engineering apart from its use in solving boundary value problems. • To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations. • To introduce the basic concepts of PDE for solving standard partial differential equations. • To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems					
Outcomes:	• Understand the concepts of function of a complex variable and complex integration and apply these ideas to solve problems occurring in the area of engineering and technology. • Solve differential equations using Fourier series analysis which plays an important role in engineering applications. • Understand the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations. • Understand how to solve and use in engineering applications for the given standard partial differential equations • Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.					

Unit I Function of complex variables **(12 Hours)**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation. standard transformations like w = z+c, cz, z2, ez, sin z, cos h z and z+1/z

Unit II Complex integration **(12 Hours)**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

Unit III Solution of Equations and Eigen value Problems **(12 Hours)**

Dirichlet's conditions – General Fourier series – Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems. Root Mean Square Value – Parseval's theorem on Fourier Coefficients. Complex form of Fourier series – Harmonic Analysis.

Unit IV Partial Differential Equations (12 Hours)

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

Unit V Interpolation, Numerical Differentiation and Numerical Integration (12 Hours)

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

Text Books

1. Veerarajan T., Engineering Mathematics for first year, Tata-McGraw Hill, 2010.
2. Venkataraman M.K., Engineering Mathematics, Vol. II & III, National Publishing Company, Chennai, 2012.

References

1. Kandasamy P. et al, Engineering Mathematics, Vol. II & III, S. Chand & Co., New Delhi, 2012.
2. Bali N. P and Manish Goyal, Text book of Engineering Mathematics, Third Edition, Laxmi Publications (p) Ltd., 2008.
3. Grewal B.S., Higher Engineering Mathematics, 40th Edition, Khanna Publishers, Delhi 2007.
4. Erwin Kreyszig, Advanced Engineering Mathematics, Seventh Edition, Wiley India, 2007.
5. Kandasamy P. et al, Engineering Mathematics, Vol. II & III, S. Chand & Co., New Delhi, 2012.

MTT31	STRENGTH OF MATERIALS	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To understand the concepts of stress, strain, principal stresses and principal planes • To study the concept of shearing force and bending moment effect due to the external loads on beams. • 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 stresses and deformations induced in thin and thick shells.					
Outcomes:	• Understand the concepts of stress and strain in simple and compound bars, the 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 the basic equation of simple torsion in designing of shafts and helical spring • Enable the students to calculate the slope and deflection in beams by using various methods. • Analyze and design of thin and thick shells for the given applied internal and external pressures.					

Unit I Stress, Strain and Deformation of Solids (12 Hours)

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.

Unit II Transverse Loading on Beams and Stresses in Beam (12 Hours)

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.

Unit III Torsion (12 Hours)

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.

Unit IV Deflection of Beams (12 Hours)

Elastic curve of neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method and Macaulay's method.

Unit V Thin Cylinders, Spheres and Thick Cylinders (12 Hours)

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.

Text Books

1. Bansal R.K, “Strength of Materials”, Laxmi Publications, Sixth Edition 2019.
2. Bedi D.S, “Strength of Materials”, Khanna Publishing, Sixth 2019.
3. Rajput R.K, “Strength of Materials”, S. Chand Publications, Seventh Edition 2018.
4. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., Second Edition New Delhi, 2018.

References

1. Punmia, Jain and Jain, “Mechanics of Materials” , Laxmi Publications, 2019
2. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, 9th Edition, 2018.
3. Egor. P.Popov “Mechanics of Materials” Pearson Education, 2nd Edition, 2016.
4. Subramanian R, “Strength of Materials”, Oxford University Press, 3rd Edition 2016.

MTT32	FLUID MECHANICS AND MACHINERY	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To introduce the properties of the fluid and flow characteristics. • To introduce the concept of boundary layer phenomenon and flow through circular conduits. • To understand the concept of impact of jets. • To introduce the concepts of turbines and complexities involved in solving the fluid flow problems. • To understand the importance of pumps and its energy exchange process					
Outcomes:	• Understand the basic fluid property and its application. • Understanding the concepts of boundary layer phenomenon and its importance • Enable the students to understand the impacts of jet on turbo machinery • Understand the working of turbine and its energy calculation • Acquire knowledge about the pumps and performance					

Unit I Fluid Properties and Flow Characteristics (12 Hours)

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

Unit II Flow Through Circular Conduits (12 Hours)

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – friction factor Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

Unit III Impact of Jets (12 Hours)

Principles of Turbo Machinery: Fluid Machines – Classification – Impact of Fluid Jet on Stationary plates, Moving Plates and Vanes – Unit and Specific Quantities.

Unit IV Hydraulic Turbines (12 Hours)

Classification – Impulse Turbine – Pelton Wheel – Reaction Turbines – Francis and Kaplan Turbines – Draft Tube Theory – Velocity Triangle – Estimation of force, Power and efficiency – General Characteristics of Turbine – Similarity Study – Governing of Turbine – Cavitation in Turbine.

Unit V Hydraulic pumps (12 Hours)

Classification - Centrifugal Pump – Velocity Triangle – Estimation of Power Required and efficiency – General characteristics - Similarity study – Cavitation in Pump – Reciprocating Pump – Air Vessels – Ideal and Actual Indicator Diagram – Estimation of Power Required, percentage Slip and Efficiency – Cavitation in Reciprocating pump.

Text Books

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, Ninth Edition, 2010.
2. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, Eighth Edition, 2009.

References

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi publications (P) Ltd., New Delhi, Tenth Edition, 2018
2. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, New Delhi, Eighth Edition, 2016.

MTT33	ANALOG CIRCUITS DESIGN	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To understand in detail the operation, characteristics and various parameters of diodes. • To learn and gain insight into the operation, characteristics and functional aspects of BJT in different configurations • To study the construction, operation and characteristics of several special semiconductor devices. • To design the different types of feedback amplifier and oscillator • To acquaint the various rectifier circuits with filters and IC regulator circuits.					
Outcomes:	• Could understand in detail the operation, characteristics and various parameters of Semiconductor diodes. • Understand the operation, characteristics and functional aspects of BJT and FET in different configurations. • Gain knowledge about the working principle of special semiconductor devices and can elucidate the circuit designs. • Gain the knowledge in design of feedback amplifier and oscillator and can design real-time oscillation. • Could design and analyze the rectifier and regulated circuits.					

Unit I Semiconductor diode **(12 Hours)**

Theory of PN junction diode, Band structure of open circuited PN junction, Volt Ampere Characteristics, Temperature Dependence of PN diode, LED, LCD and Photo- diodes, Tunnel diode, Zener diode as Voltage Regulator.

Unit II Transistors, Characteristics and Biasing **(12 Hours)**

Transistor, Types of Transistor, Transistor current components, Transistor as an Amplifier, Transistor characteristics in CB, CE and CC modes. Operating point, bias stability, various biasing circuits, stabilization against Ico, VBE and beta, Construction, Characteristics &applications of Junction Field Effect Transistor (JFET), UJT and MOSFET.

Unit III Special Semiconductor Devices **(12 Hours)**

Construction, principle of operation and characteristics of Schottky barrier 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.

Unit IV Feedback Amplifiers and Oscillator **(12 Hours)**

Feedback Concept, Effect of negative feedback on gain, bandwidth, stability, distortion and frequency Response, Sinusoidal Oscillators, Sinusoidal oscillators; criterionfor oscillation, Different types of oscillators: RC Phase Shift, Wein Bridge, Hartley, Colpitts and CrystalOscillators. Derivation of expression for frequency and amplitude of these oscillators.

Unit V Power Supplies **(12 Hours)**

Rectifiers – Half wave, Full wave and bridge rectifier – Ripple factor calculation for C, L, LC and CLC filter. Voltage regulators – Shunt voltage regulator – Series voltage regulator – Short circuit protection circuit – Current limiting circuit – Foldback limiting – Op-Amp voltage regulator – Switching regulator – Step up and step down converters.

Text Books

1. Electronic Devices & Circuits by Salivahanan published Tata McGraw Hill Publishing Co Ltd, 2015
2. Electronic Devices & Circuits Theory by Boylested, Pearson Education. 2015
3. Electronic Fundamentals & Application, by J.D. Ryder, PHI. 2009

References

1. Electronic Devices, 10th Edition by Thomas L. Floyd, Pearson Education, 2018
2. Electronics Devices & Circuits by J.B.Gupta, Katson.2013

MTT34	ELECTRICAL MACHINES	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To identify the ways and means to solve magnetically coupled circuits • To understand the different operations of DC and AC machines. • To analyze the utilization of different home appliances. • To analyze the synchronous motors					
Outcomes:	At the end of the course the students • Will be able to describe the fundamental parts of various transformers. • Explain the operating principles of induction machines, synchronous machines and dc machines • Use equivalent circuits to analyze electrical machines in steady state • Describe the principle of synchronous machines					

Unit I Transformers **(12 Hours)**

Principle of operation – Single Phase transformer – Equivalent circuit – Regulation – Losses and Efficiency – Introduction to 3 phase transformers – Autotransformers

Unit II D.C. Machines - **(12 Hours)**

Construction, Principles of operation of DC Generators – types -EMF equation – No load and Load characteristics of series and shunt generators – DC motor – Torque – Speed – Torque characteristics of series and shunt motors – Speed control methods and application.

Unit III A.C. Machines **(12 Hours)**

Principle of operation of 3-phase Induction Motor – Torque, slips characteristics – Speed control methods – Single-phase Induction motor starting methods – Principle of operation of Alternators.

Unit IV Special Machines - **(12 Hours)**

Servo motor – DC and AC servomotors; stepper motors – variable reluctance and permanent magnet stepper motors; single phase synchronous motor – reluctance motor and hysteresis motor – universal motor – Repulsion motor –synchronous motor.

Unit V Synchronous Machines **(12 Hours)**

Introduction to Polyphase Synchronous Machines, Synchronous-Machine Inductances; Equivalent Circuits, Open- and Short-Circuit Characteristics, Steady-State Power-Angle Characteristics, Steady-State Operating Characteristics, Effects of Salient Poles; Introduction to Direct- and Quadrature-Axis Theory, Power-Angle Characteristics of Salient-Pole Machines, Permanent-Magnet AC Motors

Text Books

1. B.L. Theraja, Electrical Technology Vol.II AC/DC Machines, S. Chand, 2016
2. A.Chakrabarti, M.I.Soni, P.V.Gupta,Textbook on power systems engineering, DhanpatRai, 2016. .

References

1. Battacharya S K, Electrical Machines‖, Technical Teachers Training institute, 2nd edition.2016.
2. Gupta J.B., Theory and Performance of Electrical Machines‖, J.K.Kataria& Sons, 13th edition, 2016.
3. Uppal S.L., Electrical power, Khanna Publications (p) Ltd, Delhi, 2016.
4. Garg G.C.,Utilisation of Electric power and electric traction‖ Khanna Publications (p) Ltd, Delhi, 2017.

MTT35	DIGITAL CIRCUITS DESIGN	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To present the Digital fundamentals, Boolean algebra and its applications in digital systems • To familiarize with the design of various combinational digital circuits using logic gates • To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits • To explain the various semiconductor memories and related technology • To introduce the electronic circuits involved in the making of logic gates					
Outcomes:	• Use digital electronics in the present contemporary world • Design various combinational digital circuits using logic gates • Do the analysis and design procedures for synchronous and asynchronous sequential circuits • Acquire knowledge can be used to expand semiconductor memories and related technology.					

Unit I Digital Fundamentals **(12 Hours)**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

Unit II Combinational Circuit Design **(12 Hours)**

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

Unit III Synchronous Sequential Circuits **(12 Hours)**

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

Unit IV Asynchronous Sequential Circuits **(12 Hours)**

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

Unit V Memory Devices And Digital Integrated Circuits **(12 Hours)**

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.

Text Books

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.

References

1. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011
3. S.Salivahanan and S.Arivazhagan“Digital Electronics”, Ist Edition, Vikas Publishing House pvt Ltd, 2012.
4. Anil K.Maini “Digital Electronics”, Wiley, 2014.
5. A.Anand Kumar “Fundamentals of Digital Circuits”, 4th Edition, PHI Learning Private Limited, 2016.
6. Soumitra Kumar Mandal “ Digital Electronics”, McGraw Hill Education Private Limited, 2016.

MTP31	STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY LAB	L	T	P	C
		0	0	3	2
Objectives:	• To study the mechanical properties of materials when subjected to the different types of loading. • To enable the students to impart knowledge on flow measurement equipments and performance test on different fluid machinery				
Outcomes:	• Ability to perform tension, torsion, hardness, compression, and other tests on various materials as per standards. • Acquiring basic knowledge in flow measurement equipments and Understanding the performance test on fluid machinery				

STRENGTH OF MATERIALS

List of Experiments

1. Tension test on a mild steel rod.
2. Double shear test on Mild steel and Aluminium rods.
3. Impact test on metal specimen
4. Hardness test on metals - Brinnell and Rockwell Hardness Number.
5. Deflection test on beams.
6. Compression test on helical springs.

FLUID MECHANICS AND MACHINERY LABORATORY

List of Experiments

1. Determination of the Coefficient of discharge of given Orificemeter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Conducting experiments and drawing the characteristic curves of Centrifugal pump.
4. Conducting experiments and drawing the characteristic curves of reciprocating pump.
5. Conducting experiments and drawing the characteristic curves of Gear pump.
6. Conducting experiments and drawing the characteristic curves of Pelton wheel.

MTP32	ELECTRICAL MACHINES LAB	L	T	P	C
		0	0	3	2
Objectives:	• To familiarize the basic concepts of electrical circuits and associated theorems. • To understand the load test and performance characteristics of DC shunt motor, stepper motor and induction motors.				
Outcomes:	• Test and assess the performances of the DC motors and single phase AC motor for varying load. • Knowledge in Control the speed of AC and DC motor is used to choose for appropriate applications				

List of Experiments

1. Load test on D.C. shunt motor.
2. Speed control of D.C. shunt motor.
3. Swinburne's test.
4. Load test on three phase induction motor.
5. No load and blocked rotor tests on three – phase induction motor.
6. Load test on single phase induction motor.
7. No load and blocked rotor tests on single phase induction motor.
8. Load test on Synchronous motors.
9. Performance characteristics of Stepper motor.
10. Performance characteristics of single phase transformer.

MTP33	ANALOG AND DIGITAL CIRCUITS LAB	L	T	P	C
		0	0	3	2
Objectives:	• To study about the VI characteristics of PN junction diode, Zener Diode, UJT, SCR. • To design and implement the digital circuits.				
Outcomes:	• Acquire a basic knowledge in solid state electronics including diode, FET, BJT. • An ability to design various synchronous sequential circuits design such as Counters and Shift Registers				

List of Experiments

1. V-I characteristics of semiconductor diodes
   a) PN Junction diode b) Point contact diode c) Zener diode
2. Characteristics of BJT in CE configuration
   a) Determination of input and output characteristics
   b) Determination of voltage gain, current gain, input and output resistances from the characteristics
3. Characteristics of JFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, rd, gm and μ from the characteristics
4. Characteristics of MOSFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, rd, gm and μ from the characteristics
5. Rectifier and Voltage Regulators
   a) Determination of ripple factor for different types of rectifiers with and without filters.
   b) Voltage regulation characteristics of shunt, series and IC regulators
6. i) Clipper circuits using diodes
   Positive, negative, biased and combinational clippers ii) Switching circuit
   a) AND and OR logic gates using diodes b) NOT gate using transistor
7. Study of Logic gates
8. Design and implementation of the following Code convertors
   i.BCD to excess-3 code and vice versa ii. Binary to gray code and vice-versa
9. Design and implementation of 4 bit binary adder/ subtractor and BCD adder.
10. Design and implement a multiplexer and de-multiplexer
11. Design and implement an encoder and decoder
12. Construction and verification of 4 bit ripple counter and Mod 10 Ripple counter.
13. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops

MAT41	STATISTICS AND NUMERICAL METHODS	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• 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.					
Outcomes:	• Interpret the concept of testing of hypothesis for small and large samples in real life problems • Interpret the basic concepts of classifications of design of experiments in the various fields. • Analyse the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems. • Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations. • Ability to solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.					

Unit I Testing of Hypothesis **(12 Hours)**

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

Unit II Design of Experiments **(12 Hours)**

ANOVA - one way and two way classifications - Completely randomized design – Randomized block design – Latin square design - complete factorial design.

Unit III Solution of Equations and Eigen value Problems **(12 Hours)**

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 – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices

Unit IV Interpolation, Numerical Differentiation and Numerical Integration (12 Hours)

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.

Unit V Numerical Solution of Ordinary Differential Equations (12 Hours)

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.

Text Books

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", Khanna Publishers, Tenth Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, Eighth Edition, 2015.

References

1. Burden, R.L and Faires, J.D, "Numerical Analysis", Nineth Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, Eighth 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., "Probability and Statistics for Engineers and Scientists", Pearson Education Asia, Eighth Edition, 2007.

MTT41	MECHANICS OF MACHINES - I	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To learn the basics of various mechanisms involved in machines • To introduce the methods to solve velocity and acceleration • To acquaint knowledge in the construction of cam profile • To understand the effects of friction in transmission and machine components • To introduce the concept of gear ratio for simple, compound, reverted and epicycle gear train					
Outcomes:	• Acquire knowledge on basics and working of commonly used mechanisms • Know the construction of velocity and acceleration diagrams • Understand and interpret the cam profile • Acquire the knowledge about the effects of friction in machine components • Understand the concepts of gears and gear trains					

Unit I Basics of Mechanisms **(12 Hours)**

Basic concepts of link, pair, chain, mechanism, machine and structure - degree of freedom – mobility of mechanism - Kutzbach criterion - Grashoffs law - Inversions of mechanisms: Four bar and slider crank - Mechanical advantage - Transmission angle - Description of some common mechanisms: Straight line generators, dwell mechanisms, ratchets and escapements, universal joint – Basic structures of Robot manipulators (serial and parallel).

Unit II Kinematics **(12 Hours)**

Displacement, velocity and acceleration - Graphical method of velocity (relative velocity method) and acceleration diagrams for simple mechanisms - Kliens construction for single slider crank mechanism- Coriolis component of acceleration.

Unit III Kinematics of CAM **(12 Hours)**

Classifications of Cam and follower - Radial cam nomenclature - Analysis of follower motion: uniform velocity motion, Simple harmonic motion, uniform acceleration and retardation motion and cycloidal motion - Construction of cam profile for a radial cam - Pressure angle – undercutting.

Unit IV Friction **(12 Hours)**

Types of Friction: Static, Dynamic and Rolling friction - Laws of Friction in inclined plane and screw threads - Friction in Journal bearings Friction in clutches: Single plate, multiplate clutches and cone clutches - Friction in flat and V-belt drives - Friction aspects in brakes.

Unit V Gears and Gear Trains **(12 Hours)**

Law of toothed gearing - Involutes and cycloidal tooth profiles - Spur gear terminology and definitions - Gear tooth action - Interference and undercutting Problems Helical, bevel, worm, rack and pinion gears [basics only] - Introduction to gear correction - gear trains: Speed ratio - train value -Parallel axis gear trains - Epicyclic gear trains - Determination of gear speeds using tabular method

Text Books

1. Rattan S.S, Theory of Machines, Tata McGraw Hill Publishing Company Limited, New Delhi, 2014.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, Third Edition, 2009.

References

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, Third Edition, 2005.
2. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2005
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
4. Sadhu Sigh : Theory of Machines, "Kinematics of Machine", Third Edition, Pearson Education, 2012
5. Khurmi, R.S., ”Theory of Machines”, S Chand Publications, Fourteenth Edition, 2005.

MTT42	THERMAL ENGINEERING AND HEAT TRANSFER	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To introduce the basics of IC engine and its performance. • To understand the concepts involved and various types of jet and rocket propulsion engine • To understand the application of various experimental heat transfer correlations in engineering calculations • To learn about fundamental of heat conduction process. • To impart knowledge about convection mode of heat transfer • To impart knowledge about radiation.					
Outcomes:	• Enable the students to understand the fundamentals of IC engines. • Enable the students to understand the fundamentals of Jet and rocket propulsion. • Acquire knowledge in heat conduction mechanism. • Understand the convective heat process. • Understand the knowledge about radiation concepts.					

Unit I IC Engines **(12 Hours)**

Classification of IC engines – petrol and diesel engines; two stroke and four stroke engines – scavenging in two stroke engines - port and valve timing diagram - fuel supply system in SI and CI engines - ignition system and its types – cooling system and its types – lubrication system and its types - lubricants - governing of IC engines – engine operating characteristics – power – cruising – idle and low engine speed – high engine speed – cold start - performance characteristics – heat balance test for IC engines.

Unit II Jet Propulsion **(12 Hours)**

Principle of jet propulsion – air craft jet engines – jet engine cycle – turbojet – turbofan – turboprop – turbofan engines - engine performance – thrust and efficiency, thrust power, propulsion power, propulsion efficiency and thermal efficiency – engine aircraft matching. Rocket engines – introduction – space missions.

Unit III Heat Transfer: Conduction **(12 Hours)**

Basic Concepts- Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law of Conduction - General Differential equation of Heat Conduction -Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction

Unit IV Convection **(12 Hours)**

Convection: Basic Concepts -Heat Transfer Coefficients - Boundary Layer Concept - Types of Convection - Forced Convection - External Flow and Internal Flow - Flow over Plates, Cylinders and Spheres.

Unit V Radiation **(12 Hours)**

Basic Concepts, Laws of Radiation - Stefan Boltzmann Law, Kirchhoff's Law -Black Body Radiation and radiation between different surfaces

Text Books

1. Collin R. Ferguson, Internal Combustion Engines-Applied Thermo sciences, John Wiley& Sons, Third Edition, 2015.
2. Yahya S.M., Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, New Age International, New Delhi, Sixth Edition, 2018.
3. Incropera F.P and Dewitt D.P., Fundamentals of Heat and Mass Transfer, IV Edition, John Wiley &Sons, Eighth Edition, 2017.

References

1. Ganesan. V, Internal Combustion Engines, Tata McGraw Hill, Fourth Edition, 2012.
2. Ronald D. Flack, Fundamentals of Jet Propulsion with Applications, Cambridge University Press, 2010.
3. Sachdeva R.C, Fundamentals of Engineering Heat and Mass Transfer, New Academic Science Ltd, Fifth Edition, 2017.

MTT43	MANUFACTURING TECHNOLOGY	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To impart knowledge on casting technology and foundry shop • To study about bulk deformation processes of metals • To learn about the various machines tools and its metal removal processes • To impart knowledge on various metal joining processes • To study about the various surface finishing processes					
Outcomes:	• Acquire complete knowledge about casting • Recognize the various metal forming processes • Learn the various metal removal processes • Familiarize the principles of metal joining processes • Acquaint knowledge on various surface finishing processes					

Unit I Foundry Technology **(12 Hours)**

Introduction to Molding and Casting. Molding sand: types, properties, preparation of green sand molding. Pattern making: Pattern materials, types and allowances. Core making: types of core, core materials, making of cores. Casting methods: Die casting, Centrifugal Castings, Investment Casting and Shell mold Casting. Defects in casting.

Unit II Metal Forming Processes **(12 Hours)**

Rolling: Introduction, Rolling mills, Rolling operations. Extrusion: Forward and Backward extrusion, Production of seamless tubing and pipes, Cold and Hydrostatic Extrusion. Drawing: Introduction, Hot and Cold drawing, Deep drawing, Tube and wire drawing. Sheet metal and forging operations.

Unit III Metal Removal Processes **(12 Hours)**

Lathe: types, main parts and operations, single point cutting tool nomenclature. Drilling Machine: Types, operations, types of drills, twist drill nomenclature, reaming and tapping. Milling Machine: Types, operations, types of milling cutters. Shaper and Planer: types, main parts, operations. (Numerical problems in Lathe, Drilling and Milling operations).

Unit IV Metal Joining Processes **(12 Hours)**

Classification of Welding Process. Fusion Welding: Arc Welding, Gas Tungsten Arc welding, Gas Metal Arc Welding, Electron Beam Welding, Laser Beam Welding. Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding, Resistance Welding and Explosive Welding. Gas welding: Oxy - Acetylene welding process. Weld defects: types, causes and cure. Brazing and soldering: Concepts and applications

Unit V Metal Finishing Processes **(12 Hours)**

Grinding Machine: Methods of grinding, Types of grinding machines, Grinding wheel and its selection, Lapping, Honing and Super finishing operations. Broaching Machine: pull type and push type broachers, broaching methods, operations and types of broaching machines.

Text Books

1. Kaushish J.P., “Manufacturing Processes”, Second Edition, PHI Learning Pvt. Ltd., 2013.
2. Rao P.N., “Manufacturing Technology, Volume I & II”, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition, 2018.
3. Kalpakjian. S and Schmid. R, “Manufacturing Engineering and Technology”, Seventh Edition, Pearson Education India Edition, 2013.

References

1. Adithan. M and Gupta. A.B., “Manufacturing Technology”, New Age, Fifth Edition, 2012.
2. H.M.T. Production Technology – Handbook”, Tata McGraw-Hill, First Edition, 2001.
3. Jain. R.K. and S.C. Gupta, “Production Technology”, Khanna Publishers, Sixteenth Edition, 2001.

MTT44	SENSORS, TRANSDUCERS AND MEASUREMENTS SYSTEM	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To learn basic concepts of measurement system • To select suitable non-electrical, electrical transducers and sensors for various measurements • To Identify suitable electrical transducers and sensors for various measurements • To explore advanced sensors for measurements					
Outcomes:	• Identity the measurement system and error. • Ability to choose non-electrical, electrical transducers and sensors for various measurements • Able to identify suitable electrical transducers and analysis for various measurement. • Explore advanced sensors for measurements • Acquire Knowledge to design signal conditioning circuit to interface with processor.					

Unit I Introduction to Measurement Systems **(12 Hours)**

Functional elements of Measurement System - Methods of Measurement - Classification of Instruments – Measurement system errors - Error analysis – Static and dynamic characteristics of transducers – Classification of transducers - Selection of transducers - Calibration of Instruments.

Unit II Non-Electrical Transducers **(12 Hours)**

Temperature Measurement: Filled system thermometer – Bimetallic thermometer. Pressure Transducers: Elastic transducers – Bourdon gauge – Bellows – Diaphragm. Vacuum Measurement: McLeod gauge, Thermal conductivity gauge – Ionization gauge. Flow Measurement: Rotameter- Orifice. Level measurement: Float gauge.

Unit III Electrical Transducers **(12 Hours)**

Resistive transducers: Potentiometer, RTD, Thermistor – Thermocouple – Strain gauge – torque measurement - force measurement – Radiation Measurement using Pyrometers. Inductive transducer: LVDT, RVDT – Capacitive transducer.

Unit IV Miscellaneous Transducer And Sensors **(12 Hours)**

Flow measurement: Turbine meter – hot-wire anemometer. Level Measurement: Capacitive and Ultrasonic level sensors. Measurement of Humidity – Sound measurement – Piezoelectric transducer - Hall Effect transducer –Magneto elastic sensor. Digital transducers: Encoders – Fiber optic sensors – Film sensors - Introduction to MEMS and Nano sensors.

Unit V Signal Conditioning And Digital Instruments **(12 Hours)**

DC Bridges: Classification of Resistances-Measurement of Medium Resistance -Wheatstone Bridge, Kelvin‘s Double Bridge. AC Bridges: Introduction -Sources and Detectors - Maxwell‘s Inductance Bridge -Wien‘s Bridge - Digital Instruments: Block diagram of Oscilloscope - Digital Storage Oscilloscope.

Text Books

1. Sawhney A. K., "A Course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai & Co, New Delhi, Seventh Edition, 2015.
2. Patranabis D., Sensors and Transducers, Second Edition, PHI, New Delhi, 2003.
   Doebelin E.O., Measurement Systems: Applications and Design, Tata McGraw Hill, 2004.

References

1. Sawhney A. K., "A Course in Electrical and Electronic Measurement and Instrumentation", DhanpatRai & Co, New Delhi, Seventh Edition, 2015.
2. Patranabis D., Sensors and Transducers, Second Edition, PHI, New Delhi, 2003.

MTT45	POWER ELECTRONICS AND DRIVES	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To obtain the switching characteristics of different types of power semi-conductor devices • To determine the operation, characteristics and performance parameters of converters • To understand the concept of DC and AC drives					
Outcomes:	• Know the construction, operation and characteristics of different types of power semiconductor devices. • Understand the operation, characteristics and performance parameters of converters and choppers. • Acquire the knowledge in the operation and characteristics of invertors and its related techniques. • Acquire the knowledge on solid-state DC drives and its control.					

Unit I Power Semi-Conductor Devices **(12 Hours)**

Construction, Operation, Characteristics of Power Diode - SCR - TRIAC - Power transistor, MOSFET and IGBT - di/dt and dv/dt protection.

Unit II Converters And Choppers **(12 Hours)**

Phase Control - Single Phase and Three phase uncontrolled and controlled rectifiers with R and RL load, Choppers, Time ratio control, Types, Buck-boost chopper-four quadrant operation, Cyclo converters

Unit III Inverter **(12 Hours)**

Single phase and three phase (both 120 ° and 180 ° modes.) voltage source inverters – PWM techniques: Sinusoidal PWM modified sinusoidal PWM and multiple PWM - Current source inverters- Harmonics elimination technique

Unit IV Solid State Dc Drives **(12 Hours)**

Types of electrical drives - selection of drives - heating and cooling curves - Four quadrant operation of hoist -Ward Leonard control system - Control of DC drives using rectifiers and choppers.

Unit V Solid State AC Drives **(12 Hours)**

Control of three phase induction motors using stator voltage and frequency control – variable frequency drive - static rotor resistance control - Slip power recovery schemes - Static Kramer control method - Static Scherbius control method - Power factor correction.

Text Books

1. Muhammad H. Rashid, Power Electronics - Circuits, Devices and Applications, Prentice Hall of India Learning. Ltd., New Delhi, 2013
2. Dubey G. K., Fundamentals of Electrical Drives, Wiley Eastern Ltd., New Delhi, 2007
3. Pillai S. K., A First Course on Electrical Drives, New Age International Pvt. Ltd., New Delhi, 2012.

References

1. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
2. Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2007.
3. Bhimbra P. S., Power Electronics, Khanna Publishers, New Delhi, 2012.

MTP41	SENSORS, TRANSDUCERS AND MEASUREMENT LAB	L	T	P	C
		0	0	3	2
Objectives:	• To provide the basic understanding about operational characteristics and applications of various sensors and transducers. • To provide the basic understanding about operational characteristics and applications of various measurement devices.				
Outcomes:	• Perform the signal conditioning circuits for sensor applications • Demonstrate the characteristics of sensor measurement system				

List of Experiments

1. Measurement of temperature using: Thermistor
2. Measurement of temperature using Thermocouple & RTD.
3. Measurement of displacement using POT, LVDT & Capacitive transducer.
4. Measurement of Torque, Strain and Force.
5. Flow measurement using Orifice meter and Rotameter.
6. Diaphragm based Pressure measurement.
7. Capacitive based Level Measurement.
8. Speed Measurement using Encoder and Opt coupler
9. Measurement of magnetic field strength using Hall Effect sensor.
10. Measurement of unknown Resistance using Wheatstone Bridge
11. Measurement of unknown Inductance using Maxwell Bridge
12. Measurement of unknown Capacitance using Schering Bridge

MTP42	MANUFACTURING TECHNOLOGY LAB	L	T	P	C
		0	0	3	2
Objectives:	• To study and practice the various operations that can be performed in lathe, drilling, milling, planning and shaping machines. • To equip with their practical knowledge required in the core industries.				
Outcomes:	• Ability to use different machine tools for finishing operations • Ability to use different machine tools for industrial applications.				

List of Experiments

LATHE PRACTICE

1. Plain Turning
2. Taper Turning
3. Thread Cutting

DRILLING PRACTICE

1. Drilling
2. Tapping
3. Reaming.

MILLING

1. Surface Milling.
2. Gear Cutting.
3. Contour Milling.

PLANNING AND SHAPING

1. Cutting Key Ways.
2. Dovetail machining

MTP43	COMPUTER AIDED DRAFTING LAB	L	T	P	C
		0	0	3	2
Objectives:	• To make the students understand and interpret drawings of machine components and draft them using Autocad. • To draft various Circuits and Panel Layouts using Autocad.				
Outcomes:	• Understand detailed Parts and assembly drawings of Mechanical Components and create part drawings, sectional views and assembly drawings as per standards. • Students will develop and design circuits.				

List of Experiments

2D Drafting of Mechanical Components

Preparation of Drawings for Parts and Assembly of the following by using Drafting software

- Bearings - Bush bearing
- Plummer block
- Valves – Safety and non-return valves
- Knuckle Joint and Flange Coupling

2D Drafting of Electronic Circuits

- Introduction of Symbols and Circuits
- Diode, BJT,FET, Relay, Switch using symbols
- PLC Circuits and Panel Layouts
- PCB Layout for Electronic Circuits

MTT51	MECHANICS OF MACHINES- II	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To perform force analysis and balancing of reciprocating engines and to determine basic parameters of flywheel and its functions • To perform balancing of rotating and reciprocating masses • To understand the effects of free vibration in single and multi-degree of freedom systems • To understand the dynamic effect of undesirable forced vibrations. • To understand the principles and mechanisms used for speed control and stability control.					
Outcomes:	• Carry out static and dynamic force analysis on various parts of reciprocating engine and to determine flywheel parameters by constructing turning moment diagram • Calculate the balancing masses and their locations of reciprocating and rotating masses. • Compute the frequency of free vibration in single and multi-degree of freedom systems • Compute the frequency of forced vibration in damped and undamped systems • Calculate the speed, lift of the governor, and estimate the gyroscopic effect on automobiles, ships and airplanes.					

Unit I Force Analysis **(12 Hours**

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of Cam- follower mechanism.

Unit II Balancing **(12 Hours)**

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors

Unit III Free Vibration **(12 Hours)**

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

Unit IV Forced Vibration **(12 Hours)**

Response of one degree freedom systems to periodic forcing – Harmonic disturbances –Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

Unit V Mechanism for Control **(12 Hours)**

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

Text books:

1. Rattan S.S.,Theory of Machines,3rd edition, Tata McGraw-Hill Education India,2108
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3 edition, Publisher: Pearson Education India,2011

Reference books:

1. Michael Stanisic,Mechanisms and Machines: Kinematics, Dynamics, and Synthesis,6th edition, university of notre Dame press, 2017
2. W.L.Cleghorn., "Mechanisms of Machines", Oxford University Press, 2014
3. R.S.Khurmi,.,"Theory of Machines", 14th Edition, S Chand Publications, 2005
4. A.Ghosh. andA.K. Mallick,, "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006

MTT52	PROGRAMMING FOR AUTOMATION USING PYTHON	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To know the basics of algorithmic problem solving, to read and write simple Python programs. • To develop Python programs with conditionals and loops. • To define Python functions and call them. • To use Python data structures –- lists, tuples, dictionaries. • To do input/output with files in Python					
Outcomes:	• Develop algorithmic solutions to simple computational problems Read, write, execute by hand simple Python programs. • Structure simple Python programs for solving problems. • Decompose a Python program into functions. • Represent compound data using Python lists, tuples, and dictionaries. • Read and write data from/to files in Python Programs					

Unit I Algorithmic Problem Solving **(12 Hours)**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range

Unit II Data, Expressions, Statements **(12 Hours)**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

Unit III Control Flow, Functions **(12 Hours)**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search

Unit IV Lists, Tuples, Dictionaries **(12 Hours)**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

Unit V Files, Modules, Packages **(12 Hours)**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Text Books

1. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
2. A.Timothy Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015
3. Charles Dierbach, "Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.

References

1. B.Allen. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers,2016
2. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.
3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

MTT53	CNC AND METROLOGY	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To know about basic concepts of metal cutting and CNC machines • To know about various tooling systems and fixtures • To gain knowledge in part programming • To gain knowledge on linear and angular measurement systems • To gain knowledge on laser interferometer, CMM and machine vision in measurement					
Outcomes:	• Estimate the parameters of metal cutting and comprehend the basic components, drives and controls involved in a CNC system • Select various tooling systems and fixtures for CNC and identify maintenance features of CNC machines • Develop Part Programming for various machining process • Infer linear and angular measurements using various instruments and determine the surface roughness • Interpret the operations of laser interferometer, CMM and machine vision in measurement					

Unit I Basic concepts of Metal Cutting and CNC Machines (12 Hours)

Basic Concepts of Metal Cutting and CNC Machines: Introduction – Mechanics of chip formation- Mechanics of oblique cutting- Cutting forces and power- Tool life –Surface finish-Machinability.

CNC machine: Introduction- Classification – Construction details: Structure, Configuration of CNC system – Compensations for Machine accuracy – DNC – Adaptive control CNC systems, Drives and Controls - Drive Mechanism, gearbox, Spindle Drives, Axes drives - Magnetic Levitation and Linear motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re-circulating ball screws – Backlash measurement and compensation, linear motion guide ways.

Unit II Tooling for CNC Machines (12 Hours

Tooling For CNC Machines: Interchangeable tooling system – Preset and qualified tools – coolant fed tooling system – Modular fixturing – Quick change tooling system – Automatic head changers – Tooling requirements for Turning and Machining centres – Tool holders – Tool assemblies – Tool Magazines – ATC Mechanisms – Automatic Pallet Changer-Tool management. Principles of location, clamping and work holding devices.

Economics of CNC Machines and Retrofitting: Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements. Retrofitting.

Unit III Part Programming of CNC Machines (12 Hours)

Part Programming of CNC Machines: Part Program Terminology - G and M Codes – Types of interpolation. CNC part programming – Manual part programming (Turning and Milling)

Unit IV Linear and Angular Measurements **(12 Hours)**

Linear and Angular Measurements: Basic concepts: Legal metrology- Precision- Accuracy- Types of errors – Standards of measurement- Traceability – Interchangeability and selective assembly. Introduction to limits, fits and tolerances, Gauge design- Comparators-Angular measurement: bevel protractor - Angle gauges - Sine bar.

Surface Finish and Form Measurement: Measurement of surface finish: Terminology – Geometrical irregularities – Roughness – Waviness. Surface- roughness measurement methods. Screw thread metrology: Terminology- Errors in thread, Gears Terminology- Measurement of various elements of gear.

Unit V Interferometry and Laser Metrology **(12 Hours)**

Interferometry and laser Metrology: Principle of light wave interference – Optical flats -Michelson and NPL flatness interferometer, Laser interferometer. **Advances in Metrology:** Coordinate Measuring Machine (CMM): Types - Constructional features-Possible causes of **errors** in CMM - Probing system – Performance and applications of CMM. Machine Vision System**:** Applications of machine vision in measurement- In process and On line measurement.

Text books:

1. P. Radhakrishnan, Computer Numerical Control (CNC) Machines,5th edition, New Central Book Agency (P) Limited,2013
2. Graham T. Smith, CNC Machining Technology, 3RD edition, Springer Science, 2013
3. B. S. Pabla, M. Adithan,CNC Machines, 5th edition, New Age International, 2000
4. R.K. Jain, Engineering Metrology,21st edition,Kanna publisher,2008
5. M.Mahajan, Metrology, Dhanpat Rai And Co Pvt Ltd, 2011

Reference books:

1. M. Adithan, B.S. Pable, "CNC Machines", New age international publications,2016
2. Graham T. Smith, CNC Machining Technology: Volume I: Design, Development and CIM Strategies, Springer publisher,2015
3. Mahesh Dhotre, D. Rao, "CNC Machine Tool Technology with Programming and Operating", Saitech publications 2016
4. V.James , Valentino, Joseph Goldenberg,Introduction to Computer Numerical Control,2nd edition, Pearson Prentice Hall, 2007

MTT54	MICROPROCESSOR AND MICROCONTROLLER APPLICATIONS	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To gain knowledge about 8085 and 8051 microcontrollers • To know about C programming using 8051 microcontroller • To gain knowledge of internal and external peripherals • To apply microcontroller for mechatronics applications					
Outcomes:	• Infer the basic concepts of 8085 microprocessor and 8051 microcontroller • Acquire knowledge in Embedded C programming concepts with 8051 microcontroller is used to interface the real-time hardware. • Able to develop programming using internal and external peripherals with microcontroller • Design a microcontroller based system for Mechatronics applications					

Unit I 8085 Microprocessor **(12Hours)**

8085 Architecture – Pin configuration – Register organization – Memory organization – memory and I/O decoding – Interrupts

Unit II 8051 Microprocessor **(12Hours)**

Selection of Microcontrollers - 8051 Microcontroller Architecture – Pin configuration – Memory organization –Special function registers – Program Counter – PSW register – Stack and stack pointer.

Unit III 8051 Assembly Language/Embedded C Programming **(12 Hours)**

Compiler C - programming structure, Data types, memory models, infinite loops and handling interrupts in C. Intel Hex file format. Instruction set – Addressing modes – I/O port programming – Timer programming – Counter programming – Serial communication programming – Interrupt programming.

Unit IV Peripheral Interfacing **(12 Hours)**

Introduction to Embedded C programming – Peripheral interfacing Switch –key pad, LCD –LED – A/D and D/A converters – High Power devices using relays. Speed control: DC Motor –Stepper motor, servomotor.

Unit V Microcontroller for Mechatronics Applications **(12 Hours)**

Application case studies related to Interfacing of sensors analog and discrete type (Temperature, Pressure, Level, Proximity sensors). Interfacing of actuators (Servo motor, pneumatic cylinders, PWM control of a DC motor). RF module Interfacing – IR module interfacing. Traffic light control application

Text Books

1. Mazidi Muhammad Ali, Mazidi Janice Gillispie and McKinlay Rolin, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Prentice Hall of India, New Delhi, 2013.
2. Patel, "The 8051 Microcontroller based Embedded Systems", 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
3. Ramesh Goankar, "Microprocessor 8085 Architecture, Programming and Interfacing", Penram International publishers, Mumbai, 2013.

References

1. A. Nagoorkani, "8085 Microprocessor and its Applications", 2017
2. Kenneth Ayala, "The 8051 Micro controller", 3rd edition cengage learning 2007
3. Subrata Ghoshal, "Embedded Systems & Robots : Projects Using the 8051 Microcontroller", 2009

MTT55	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To know about mathematical models of electrical, mechanical and electromechanical systems • To gain knowledge about time domain responses of first and second order systems • To know about frequency response of systems • To design the compensator for uncompensated open loop systems					
Outcomes:	• Develop mathematical model of electrical, mechanical and electromechanical systems • Acquire knowledge in the time domain response of first and second order systems • Acquire knowledge in frequency response of systems which is used to analyze the stability of the system • Design the compensator for uncompensated open loop system					

Unit I System Modeling **(12 Hours)**

Basic concepts: Classification of control Systems - Open loop and Closed loop systems. Mathematical modelling (Differential equation, Transfer function and State space model): Electrical systems - Mechanical systems - Electromechanical systems (DC motor with/without Gears). Reduction of multiple subsystems: Block diagram reduction - Signal flow graphs.

Unit II Time Response Analysis **(12 Hours)**

Concepts of Poles, Zeros and System response -Type and Order of System - Significance of test signals - First order system - Second order system: Classification and nature of response - Step response of second order underdamped System - Time domain specifications - Steady state error and error constant - Generalized error series.

Unit III Stability Analysis **(12 Hours)**

Concepts of stability – Location of Poles and Zeros for stability - Routh Hurwitz Criterion - Root Locus Technique - Effect of addition of poles and zeros on stability.

Unit IV Frequency Response Analysis **(12 Hours)**

Concepts of frequency Response - Frequency domain specifications - Bode plot - Polar plot - Nyquist stability criterion.

Unit V Compensator Design **(12 Hours)**

Need for compensator - Types of compensation - Cascade compensators (Lag, Lead and Lag-Lead): Transfer function and Physical realization - Design of lag and lead compensator using Bode plot - Effect of ideal compensation on time response: P, PI, PD and PID.

Text Books

1. S.Salivahanan, Rengaraj R., Venkatakrishnan G.R., “Control Systems Engineering”, 1st Edition, Pearson Education India, 2015.

2. I.J. Nagrath and Gopal M., “Control Systems Engineering”, 6th Edition, New Age International Publishers, New Delhi, 2018.
3. S.Norman , Nise, “Control Systems Engineering”, 7th Edition, Wiley, 2015.

References

1. A.A.Kumar , “Control Systems”, second edition, PHI 2014.
2. U.A.Bakshi, V.U.Bakshi, Control System Engineering, 2nd edition, Technical Publications, 2008

MTP51	PROGRAMMING FOR AUTOMATION LAB	L	T	P	C
		0	0	3	2
Objectives:	• To write, test, and debug simple Python programs. • To implement Python programs with conditionals and loops. • Use functions for structuring Python programs.				
Outcomes:	• Represent compound data using Python lists, tuples and dictionaries. • Read and write data from/to files in Python				

List of Experiments

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

MTP52	CNC AND METROLOGY LAB	L	T	P	C
		0	0	3	2
Objectives:	• To develop, simulate and execute part program using CNC production machines • To interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments				
Outcomes:	• Develop, simulate and execute part program using CNC production machines • Interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments				

List of Experiments

1. Study of G codes and M codes for machining centre and turning centre
2. Programming and machining of given component using MTAB trainer machine
3. Programming and machining of given component using CNC turning centre
4. CNC code generation of given component using MASTER CAM (Lathe) and interfacing it to CNC turning centre
5. Programming and machining of given component using CNC machining centre
6. CNC code generation of given component using MASTER CAM (Mill) and interfacing it to CNC machining centre
7. Calibration of Vernier / Micrometer; static characteristic study- Measurement of Components like V block etc.
8. Calibration of Dial Gauge; static characteristic study; Use of dial gauge as measuring device and Comparators.
9. Calibration of profile projector and measurement of micro components.
10. Study of Autocollimator, Surface roughness tester and coordinate measuring machine (CMM).

MTP53	MICROPROCESSOR AND MICROCONTROLLER LAB	L	T	P	C
		0	0	3	2
Objectives:	• To know about programming for 8085 microprocessor and 8051 microcontrollers • To Verify programming logic and interfacing circuits using simulation software • To Develop a microcontroller based system for Mechatronics applications				
Outcomes:	• Build programming for 8085 microprocessor and 8051 microcontroller • Knowledge in programming logic and interfacing the hardware with microcontroller • Develop a microcontroller based system for Mechatronics applications				

List of Experiments

Assembly Language Programming

1. Arithmetic functions using 8085 Microprocessor
2. Arithmetic functions using 8051 Microcontroller.

Embedded C Programming and hardware interfacing using 8051 Microcontroller

3. Interfacing of switch, LED and seven segment LED
4. Interfacing of LCD
5. DC motor programming for the given case study
6. Stepper motor programming for the given case study
7. Servo motor programming for the given case study
8. Actuation of pneumatic cylinders for the given case study
9. Interfacing of high power devices for the given case study
10. Study on Interfacing sensors, microcontroller with IoT module

MTP54	GENERAL PROFICIENCY – I	L	T	P	C
		0	0	3	1
Objectives:	• To help the students to get rid of the inhibitions and communicate with ease by improving their Listening, Speaking, Reading and Writing skills of students • To ensure the personality development of the students by sharpening their soft skills				
Outcomes:	• Students will have enhanced Listening, Speaking, Reading and Writing skills • Students will have well-regulated soft skills and personality development				

Unit I Art of Communication

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

Unit II Introduction to Soft Skills

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

Unit III Writing

Importance of Writing – Written Vs Spoken Language – Formal and Informal Styles of writing – Resources for improving writing – Grammar and Usage – Vocabulary Building – SWOT analysis

Unit IV Speaking Practice

Dialogue – Telephone Etiquette – Public Speaking – Debate – Informal Discussions –Presentations

Unit V Aptitude

Verbal and Numerical aptitude

References:

1. Speaking, Group Discussions and Interviews. Prentice Hall, New Delhi, 2007.
2. Thorpe, Edgar. Course in Mental Ability and Quantitative Aptitude. Tata McGraw, 2003.
3. Thorpe, Edgar. Test of Reasoning. Tata McGraw, 2003.
4. Prasad, H.M. How to prepare for Group Discussion and Interview. Tata McGraw, 2001.
5. Career Press Editors, 101 Great Resumes. Jaico Publishing House, 2003.
6. Aggarwal R.S, A Modern Approach to Verbal and Non Verbal Reasoning.

MTT61	DESIGN OF MECHANICAL ELEMENTS	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To familiarize the various steps involved in the design process and to understand the concepts of principle stresses and strains subject to steady and variable stresses in machine components • To design shafts, keys and couplings • To design gears and analyzing the influence of stresses on it • To design brakes and clutches for automobiles with appropriate assumptions • To design bearings and springs with appropriate assumptions					
Outcomes:	• Interpret the influence of steady and variable stresses in machine component design. • Acquire knowledge on design concepts of shafts, keys and couplings with proper assumptions • Acquire knowledge on design and analyse of spur, helical, bevel, worm gear drives and multi speed gear box • Able to design and analyse clutches and braking systems • Able to design and analyse bearings and springs					

Unit I Design Fundamentals **(12 Hours)**

Design Process – Computer aided design – Optimum design – Material Standards – Industrial design form and shape design, embodiment design and design for manufacture. Types of loads –Stresses – Static, varying, thermal, impact and residual. Factors of safety – Theories of failure – Stress concentration factors – S-N curves and its applications.

Unit II Shafts and Couplings **(12 Hours)**

Design of Shafts, Keys and Couplings: Design of Solid and Hollow shafts – Based on strength, rigidity and deflection – Torsional rigidity – Lateral rigidity – Material constants. Design of Keys – Types – Keyways. Design of rigid and flexible couplings.

Unit III Design of Spur, Helical, Bevel and Worm Gears **(12 Hours)**

Principles of gear tooth action – Gear correction – Gear Materials- Gear tooth failure modes. Design of spur, helical, bevel and worm gears – Multi speed gear box design –Spur gear – Forward Traverse.

Unit IV Design of Brakes and Clutches: **(12 Hours)**

Brakes – Types – Dynamic and thermal aspects of Braking – Braking system in automobiles. Design of clutches – Single plate – Multi plate –Conical clutch – Over running clutch.

Unit V Design of Bearings and Springs **(12 Hours)**

Study of Bearings – Design of Bearings – Sliding contact –Rolling contact – Cubic mean load. Design of Journal Bearings – Calculation of Bearing dimensions – Springs - Design of Helical spring, Leaf springs – Types of springs – Wahl factor – Problems.

Text book:

1. Bhandari **V**.B., Design of Machine Elements,4th edition, McGraw Hill Education India ,2017
2. Ganesh Babu K., K. Srithar, Design Of Machine Elements,1st Edition, McGraw Hill,2009
3. Spotts M.F., Shoup T.E., Hornberger L.E., Design of Machine Elements: 8th edition, Pearson /Prentice Hall,2003

Reference books:

1. Hamrock B.J., Fundamentals of Machine Elements, 2nd edition, McGraw Hill,2004
2. Juvinall R.C. ,K.M. Marshek, Fundamentals of machine component design: 6th edition, John Wiley.2011

MTT62	FLUID POWER SYSTEM	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To understand the concepts, construction and working principles of fluid power system • To understand the construction and working of pumps and actuators for hydraulic system • To understand and identify the usage of various directional control valves in hydraulic systems • To understand the performance of pneumatic systems • To apply various methods to design and execute hydraulic and pneumatic circuits for simple applications using software and hardware tools					
Outcomes:	• Acquaint knowledge on the fundamentals of hydraulic systems and determine losses incurred in hydraulic circuit • Recognize the suitable pump and actuators for particular application • Interpret and use of various hydraulic valves • Understand the fundamentals of pneumatic systems • Design hydraulic and pneumatic circuits for simple application					

Unit I Fluid power systems **(12 Hours)**

Introduction to fluid power – History – Pascal's law – Components - Advantages – Drawbacks – Applications. Hydraulic fluids: Functions, Properties. Darcy's equation – Frictional losses – Losses in valves and fittings – Determination of head losses & pump power in a hydraulic circuit.

Unit II Hydraulic Pumps and Actuators **(12 Hours)**

Positive and Non-positive displacement pumps – Pumping theory – Pump classification – Construction and working principle of Gear, Vane and Piston pumps. Pump performance – Pump performance curves. Hydraulic cylinder (double acting) – Construction & Working principle – Double rod cylinder – Telescopic cylinder. Hydraulic motors: Gear, Vane and Piston motor.

Unit III Hydraulic Valves **(12 Hours**

Directional control valves: Check valve – Pilot operated check valve – 3/2 valves – 4/2 valves – methods of valve actuation – Shuttle valve. Pressure control valves: Pressure relief valves - Pressure reducing valve, Unloading valves, Counter balance valves - Flow control valves - Servo valves: Mechanical type.

Unit IV Pneumatic Systems **(12 Hours)**

Introduction – Properties of air – gas laws – Compressors: Piston compressor, Screw compressor and Vane compressor. Fluid conditioners: Air filters, Air pressure regulators, Air lubricators, Pneumatic silencers and Air dryers. Pneumatic actuators: Pneumatic cylinders, Rotary air motors – Performance curves.

Unit V Design of Hydraulic and Pneumatic Circuits (12 Hours)

Sequential circuit design for simple applications: Step counter method, Cascade methods &Karnaugh Veitch map method – PLC circuit design using ladder logic.

Text Books :

1. S. R. Majumdar, Oil Hydraulics, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2014
2. James L. Johnson, Introduction to Fluid Power, Delmar Thomson Learning, 2013.

References Books:

1. Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2015.
2. S. R. Mujumdar, Pneumatic systems - Principles and maintenance, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2014.
3. Andrew Parr, Hydraulics and Pneumatics, Jaico Publishing House, 2015
4. K. R. Arora, Fluid Mechanics**,** Hydraulics And Hydraulic Machines,6th edition, Standard Publishers Distributors,2005
5. Andrew Parr, Hydraulics and Pneumatics,3rd edition,Elsevier,Publisher,2011
6. Ahmed Abu Hanieh, Fluid Power Control: Hydraulics and Pneumatics, Cambridge International Science Publishing, 2012

MTT63	INDUSTRIAL ROBOTICS	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To impart knowledge on direct and inverse kinematics of manipulator • To understand the basic elements of serial and parallel robots • To learn trajectory and motion analysis of robotic movements • To learn about robot dynamics and trajectory planning • To know about various robotic sensors and application of robots in various fields					
Outcomes:	• Understand the components and parameters of industrial robots. • Understand the classification of end effectors. • Evaluate the kinematic calculations to the industrial robots. • Apply trajectory planning to the robots. • Identify sensors for robotic applications					

Unit I Introduction **(12 Hours)**

A brief history – Definition - Laws of Robotics - Basic components of robot - concept of workcell - degrees of freedom (DOF) – Resolution – Accuracy – Repeatability – Payload – Precision - classification of Industrial robot manipulator - common kinematic arrangement.

Unit II End Effectors **(12 Hours)**

Unilateral Vs Multilateral end effectors - mechanical grippers: gripping force estimation with payload under acceleration – vacuum - magnetic - air operated grippers Remote centre compliance - Robot cell layouts.

Unit III Kinematics of Robot Manipulator **(12 Hours)**

Representing position and rotation - rotation in plane - rotation in three dimension - Rotational transformation - Rotation with respect to the current frame and fixed frame - Rule for composition of rotational transformation - Parameterization of rotation - Euler angle, Roll, Pitch, Yaw angles Axis/angle representation - rigid motion - Homogeneous transformation - DenavitHartenberg convention

Unit IV Robot Dynamics and Trajectory Planning **(12 Hours)**

Velocity kinematics - Jacobian - Derivative of rotation matrix - addition of angular velocity - Derivation of Jacobian combining the linear and angular velocity Jacobian - Euler Lagrange equation, kinetic and potential energy, Equation of motion, Newton Euler formulation - Trajectory planning for point to motion - Cubic polynomial - Quintic polynomial trajectory - Linear segment with parabolic bend (LSPB) minimum time trajectory - trajectory for path specified by via point.

Unit V Robot Sensor **(12 Hours)**

Ultrasonic sensors -Range finding- time of flight LIDAR- triangulation techniques -Vision for 3D measurement - structured lighting stereo vision and camera calibration. For Further Reading - Industrial robots for welding, painting and assembly, remote Controlled robots, Robots for nuclear thermal and chemical plants, Industrial automation, typical example of automated industries, application of visual inspection

Text books:

1. P.Mikell Groover, Industrial Robotics,5th edition, McGraw-Hill Education (India) Pvt Limited,2018
2. Groover, Industrial Robotics,2nd edition, Tata McGraw-Hill Education,2012
3. P.Jaganathan, Robotics (Industrial Robotics), 1st edition, Lakshmi Publications,2013

Reference books:

1. J.J. Craig, Introduction to Robotics: Mechanics and Control, Prentice Hall Inc. / Pearson Education,2008
2. Shimon Y. Nof, Handbook of Automation, ist edition, Springer Science & Business Media, 2009
3. Harry Colestock, Industrial Robotics: Selection, Design, and Maintenance, McGraw-Hill, 2005

MTT64	INDUSTRIAL AUTOMATION	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To understand the construction, operation and installation of PLCs • To provide the knowledge on interfacing the PLCs and field devices with communication protocols. • To understand the concepts of SCADA System & Architecture • To understand the concepts of DCS and SCADA systems. • To understand the concepts of industrial process control					
Outcomes:	• Select appropriate PLC for architecture, installation procedures and trouble shooting. • Develop PLC programs using various functions of PLCs for a given application. • Explain the application development procedures in SCADA and manage data, alarm and storage. • Distinguish DCS, SCADA and PLC and explain the architecture of DCS • Describe the controller elements and program methods					

Unit I Programmable Logic Controller **(12 Hours)**

Introduction — Principles of operation – PLC Architecture and specifications – PLC hardware components Analog & digital I/O modules, CPU & memory module – Programming devices – PLC ladder diagram, Converting simple relay ladder diagram into ladder diagram. PLC programming- Simple instructions – Manually operated switches – Mechanically operated switches - Latching relays.

Unit II Applications of PLC **(12 Hours)**

Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, control instructions – Data manipulating instructions, math instructions; Applications of PLC – Motor start and stop, Simple materials handling applications, Automatic water level controller, Automatic lubrication of supplier Conveyor belt, Automatic car washing machine, Bottle label detection and process control application.

Unit III SCADA System and Architecture **(12 Hours)**

Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries - SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA/HMI Systems Various SCADA architectures, advantages and disadvantages of each system

Unit IV Distributed Control System **(12 Hours)**

Introduction to DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities Operator interfaces - Low level and high level operator interfaces – Displays - Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS – Case studies – Sugar industry and Power plant

Unit V Industrial Process Control **(12 Hours)**

Study of Advanced Process control blocks: Statistical Process Control, Model Predictive Control, Fuzzy Logic Based Control, Neural-Network Based Control, PID Control

Text Books :

1. Gary Dunning, "Introduction to Programmable Logic Controllers",3rd India edition, Cengage Learning, 2007
2. R. K. Rajput, Robotics And Industrial Automation,2nd edition, S. Chand Limited, 2008
3. A. K. Gupta, S. K. Arora,Industrial Automation and Robotics, 1st edition,Laxmi Publications, 2009
4. John Webb, "Programmable Logic Controllers: Principles and Applications",5th edition Prentice Hall of India, 2012.
5. Krishna Kant "Computer Based Process Control", Prentice Hall of India, 2004.

References books:

1. B. G. Liptak "Instrument Engineer's Handbook – Process Software and Digital Network", 3rd edition, CRC Press,2002
2. A.Jose,Romagnoli, Ahmet Palazoglu, "Introduction to Process control", CRC Taylor and Francisgroup, 2005.
3. Richard Cox, "Programmable Controllers", Delmer Thomson learning, 2001.
4. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

MTT65	DESIGN OF MECHATRONICS SYSTEM	L	T	P	C	Hours
		3	1	0	4	60
Objectives:	• To develop knowledge on Mechatronics system design and simulation, ergonomics and safety • To gain knowledge on the theoretical and practical aspects of computer interfacing, real time data acquisition and control • To gain knowledge on Mechatronic system modelling • To gain knowledge on real time interfacing • To undergo case studies on Mechatronic system					
Outcomes:	• Understand the basics and key elements of Mechatronics design process • Familiarize with basic system modeling • Familiarize with Mechatronic system modelling • Realize the concepts of real time interfacing and data acquisition • Understand the concepts of design of Mechatronic system through case studies					

Unit I Introduction to Design of Mechatronics System **(12 Hours)**

Key elements – Mechatronics design process – design parameters – mechatronics and traditional design – Advanced approaches in mechatronics design – Introduction to industrial design, modelling, simulation and analysis – Ergonomics and safety.

Unit II Basic System Modelling **(12 Hours)**

Introduction – model categories – model development – Simulation using software's – verification and validation – Mathematical modelling: Basic system modelling – mechanical electrical, fluid and thermal.

Unit III Mechatronic System Modelling **(12Hours)**

Engineering systems: Rotational – translational, electro-mechanical, pneumatic-mechanical, hydraulic-mechanical, micro electro mechanical system – Dynamic responses of system: first order, second order system – Performance measures

Unit IV Real Time Interfacing **(12 Hours)**

Introduction – Selection of interfacing standards- elements of data acquisition and control systems – Overview of I/O process – general purpose I/O cards and its installation – Data conversion process – Application software's – Man machine interface

Unit V Case Studies on Design of Mechatronics System **(12 Hours)**

Motion control using DC Motor, AC Motor and Servomotor - Temperature control of hot/cold reservoir – Pick and place robot – Car parking barriers – Motion and temperature control of washing machine – Auto focus camera, exposure control

Text Books :

1. Bodgan Wilamowski, J. David Irwin, Control and Mechatronics,1st edition, CRC Press, 2016
2. Devdasshetty S, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition, Cengage Learning,2011
3. Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sons Ltd, 2003.

References books:

1. Yigang He, Xue Qing, Automatic Control, Mechatronics and Industrial Engineering, CRC Press, 2019
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991 , First Indian print,2010..
3. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.

MTP61	VIRTUAL INSTRUMENTATION LAB	L	T	P	C
		0	0	3	2
Objectives:	• The intention and purpose of this course is to acquire knowledge about Lab VIEW Programming. • The intention and purpose of this course is to study the interfacing of different sensors with Lab VIEW.				
Outcomes:	• Interpret the software tools in virtual instrumentation • Develop programming through Lab VIEW graphical programming environment • Perform interface of data acquisition hardware with Lab VIEW software • Select the hardware and software concept of data acquisition system for advanced applications				

List of Experiments

Repetition and Loops:

1. GSD using For loops, while loops with shift registers / feedback nodes
2. GSD using Local variables and Global variables

Structures

3.GSD using Case structures and Sequence structures

4.GSD using Timed structures, Formula nodes and Event structures

Plotting data:

5. GSD using Waveform graph, Waveform chart, XY graph

Strings:

6. GSD using string functions, editing, formatting and parsing string

Arrays and clusters:

7. GSD using arrays functions and multi-dimensional arrays
8. GSD using clusters operations: assembling clusters and disassembling clusters

Modular Programming:

9. Creating sub VIs from section of a VI
10. File Input / File Output function Read / Write a file.

Data Acquisition system (DAQ or MyRio):

11. GSD for real time measurement using Thermistor / Piezo-electric sensor
12. GSD for real time monitoring using Seven-Segment LED Display/ Motor/ Buzzer/ Speaker

MTP62	INDUSTRIAL AUTOMATIONLAB	L	T	P	C
		0	0	3	2
Objectives:	• To identify the differences between various PLCs • To control some process parameters and test PID algorithm. • To use the VFD to control the speed of AC motor.				
Outcomes:	• Carryout wiring connections and troubleshoot in different PLCs. • Develop simple applications using LD, ST and FBD mode of programming. • Develop SCADA application using open source software and Perform speed control on AC motor using VFD and PLC.				

List of Experiments

1. Study of different PLCs and their specification
2. Study of installations and troubleshooting of PLC.
3. Development of Ladder Diagram (LD) and Structured Text (ST) programming in PLC for simple applications.
4. Development of an application by using timer and counter of PLC.
5. Solving simple problems using Functional Block Diagram (FBD) programming in PLC
6. Interfacing between PLC and Process loop (temperature)
7. Interfacing between PLC and Process loop (level)
8. Interfacing between PLC and Process loop (flow)
9. Verification and testing of PID controller in a process loop.
10. Develop one application using SCADA system.
11. AC motor speed control using PLC and VFD

MTP63	FLUID POWER SYSTEMS LAB	L	T	P	C
		0	0	3	2
Objectives:	• To understand the concepts, construction and working principles of fluid power system Components • To design circuits using ladder logic, step counter method, cascade method and KV map method				
Outcomes:	• Understanding the concepts, construction and working principles of fluid power system Components • Design circuits using ladder logic, step counter method, cascade method and KV map method				

List of Experiments

1. Identification of fluid power system components
2. Drawing standard symbols of FPS
3. Actuating Single Acting Cylinder
4. Actuating Double Acting Cylinder
5. Simple sequencing
6. Circuit design using ladder logic
7. Circuit design using step counter method
8. Circuit design using cascade method
9. Circuit design using KV map method
10. Circuit design using three methods and making comparison

MTP64	GENERAL PROFICIENCY – II	L	T	P	C
		0	0	3	1
Objectives:	• To develop the student's critical thinking and problem solving skills • To prepare the students industry- ready and employable by enabling the students to prepare for interviews and face them with confidence.				
Outcomes:	• Students will attain and enhance competence in critical thinking and problem solving skills • Students will be industry- ready with enhanced communication skill				

UNIT I Composition Analysis

Technical and Non- Technical Passages (GRE Based)- Differences in American and British English- Analyzing Contemporary issues- Expanding Terminology

UNIT II Writing

Job Application Letter- Resume Writing

UNIT III Oral Skills

Group Discussion- Introduction and Practice- Team work- Negotiation skills-Organizing and attending meetings- Facing Interviews

UNIT IV Aptitude

Verbal and Numerical aptitude

Unit V Adapting to Corporate Life

Corporate Etiquette- Grooming and Dressing

References:

1. Pushplata and Sanjay Kumar. Communicate or Collapse: A Handbook of effective public speaking, Group Discussions and Interviews. Prentice Hall, New Delhi, 2007.
2. Thorpe, Edgar. Course in Mental Ability and Quantitative Aptitude. Tata McGraw, 2003.
3. Thorpe, Edgar. Test of Reasoning. Tata McGraw, 2003.
4. Prasad, H.M. How to prepare for Group Discussion and Interview. Tata McGraw, 2001.
5. Career Press Editors, 101 Great Resumes. Jaico Publishing House, 2003.
6. Aggarwal, R.S. A Modern Approach to Verbal and Non Verbal Reasoning.
7. Chand & Co., 2004.
8. Mishra Sunita and Muralikrishna. Communication Skills for Engineers. FirstEdition. Pearson Education, 2004.

MTT71	ENGINEERING ECONOMICS AND MANAGEMENT	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To provide basic concepts and principles of economics • To study about national income estimation • To impart knowledge about marketing strategies and techniques • To enumerate the appropriate operation management concept in business situations • To learn about the accounting principles and financial statements					
Outcomes:	• Estimate market equilibrium and interpret national income calculation and inflation issues • Interpret national income calculation • Acquire knowledge about marketing concepts • Apply appropriate operation management concept in business situations • Acquire knowledge on accounting principles and financial statements					

Unit I Introduction to Economics **(12 Hours)**

Economics – Basic Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic activities and Income.

Unit II National Income and its measurement techniques **(12 Hours)**

Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Management Functions: Planning, Organizing, Staffing, Leading and Controlling - Managerial Skills - Levels of Management - Roles of manager.

Unit III Marketing Concepts **(12 Hours)**

Marketing - Core Concepts of Marketing - Four P‘s of Marketing - New product development - Product Life Cycle - Pricing Strategies and Decisions.

Unit IV Operations Management **(12 Hours)**

Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination.

Unit V Accounting Principles and Financial Statements **(12 Hours)**

Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Meaning – Types of decisions – Methods (Theory).

Text Books

1. Panneerselvam.R, "Engineering economics", PHI learning private Limited, Delhi, 2013.
2. Economics and Management for Engineers, Complied by Department of Management Studies, Kongu Engineering College, McGraw-Hill Education, India, 2013.
3. Panneerselvam.R, "Production and Operations Management ", PHI learning private Limited, Delhi, 2012

References

1. Zahid A khan: Engineering Economy, “Engineering Economy”, Dorling Kindersley, 2012
2. Geetika, PiyaliGhosh and Purba Roy Choudhury, ―Managerial Economics, 1st Edition, Tata McGraw-Hill, New Delhi, 2008.
3. Stanley L. Brue and Campbell R. Mcconnell, ―Essentials of Economics, Tata McGraw-Hill, New Delhi, 2007.
4. Jain S.P., Narang K.L. and Simi Agrawal, ―Accounting for Management, 1st Edition, Tata McGraw-Hill, New Delhi, 2009.
5. Jeff Madura, ―Fundamentals of Business, Cengage Learning Inc., India, 2007.

MTT72	EMBEDDED SYSTEM DESIGN	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To provide the overview of embedded system design principles • To understand the concepts of real time operating systems • To provide exposure to embedded system development tools with hands on experience in using basic programming techniques					
Outcomes:	• Learn the need of embedded systems and their development procedures • Understand the construction, addressing modes and instructions sets of PIC micro controller • Could understand various tools for developing embedded applications • Summaries the concepts involved in Real time operating systems and memory with respect Architecture to I/P devices • Can conduct experiments with I/O systems used in embedded systems					

Unit Introduction to Embedded System **(12 Hours)**

System Design: Definitions - Classifications and brief overview of microcontrollers – Microprocessors and DSP's - Embedded processor architectural definitions - Typical Application scenarios of embedded systems.

Unit II Processor and Memory Organization **(12 Hours)**

Bus Organization - Memory Devices and their Characteristics - Instruction Set Architecture [RISC, CISC] - Basic Embedded Processor/Microcontroller Architecture [8051, ARM, DSP, PIC] – Memory system architecture [cache, virtual, MMU and address translation] - DMA, Co-processor and Hardware Accelerators – Pipelining

Unit III I/O Devices and Networks **(12 Hours)**

I/O Devices[Timers, Counters, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices] - Memory Interfacing - I/O Device Interfacing [GPIB, FIREWIRE, USB, IRDA] - Networks for Embedded systems (CAN, I2C, SPI, USB, RS485, RS 232) -Wireless Applications [Bluetooth, Zigbee].

Unit IV Operating Systems **(12 Hours)**

Basic Features of an Operating System - Kernel Features [polled loop system, interrupt driven system, multi rate system] - Processes and Threads - Context Switching - Scheduling[RMA, EDF, fault tolerant scheduling] - Inter-process Communication - Real Time memory management [process stack management, dynamic allocation] - I/O[synchronous and asynchronous I/O, Interrupts Handling, Device drivers] - RTOS [VxWorks, RT-LINUX].

Unit V Embedded System Development **(12 Hours)**

Design Methodologies [UML as Design tool, UML notation, Requirement Analysis and Use case Modeling] - Design Examples [Telephone PBX, Inkjet Printer, PDA, Elevator Control System, ATM System] - Fault-tolerance Techniques - Reliability Evaluation Techniques.

Text Books

1. Rajkamal, 'Embedded System – Architecture, Programming, Design', Tata McGraw Hill, 2011
2. John B. Peatman, "Design with PIC Microcontrollers" Prentice Hall, 2003

References

1. Frank Vahid, Tony John Givargis, Embedded System Design: A Unified Hardware/ Software Introduction - Wiley & Sons, Inc.2002
2. Steve Heath, 'Embedded System Design', II edition, Elsevier, 2003.
3. Robert Foludi "Building Wireless Sensor Networks", O'Reilly, 2011
4. Wayne Wolf Computers as components: Principles of Embedded Computing System. Design
5. Jane W. S., Liu, Real time systems, Pearson Education, 2000
6. Micro blaze processor Reference guide, Xilinx NIOS II Processor reference Handbook, ALTERA

MTP71	COMPUTER AIDED ENGINEERING LAB	L	T	P	C
		0	0	3	2
Objectives:	• To draw the models and assembly in 3D using 3D Modeling Software • To analyze the models using ANSYS				
Outcomes:	• Explore the various CAD packages and CAE tools • Enable the student to simulate real-time condition on a product using CAE Package and validate them				

List of Experiments

1. Part and Assembly drawing of Couplings using CATIA/Creo/ SOLIDWORKS.
2. Part and Assembly drawing of Bearings using CATIA/Creo/ SOLIDWORKS.
3. Part and Assembly drawing of Valves using CATIA/Creo/ SOLIDWORKS.
4. Modeling and Drafting of Machine Elements i.e. Tail Stock/ Screw Jack / Connecting Rod using CATIA/Creo/ SOLIDWORKS
5. Structural analysis of a given component using ANSYS.
6. Thermal analysis of a given application using ANSYS.
7. Modal analysis of a given model using ANSYS.
8. Contact analysis of a model using ANSYS.
9. Shear Force and bending moment diagram using ANSYS.
10. Vibration analysis of an object using ANSYS.
11. Modeling and analyzing of any part models using CAD and CAE packages

Reference

1. Bhatt.N.D. and Panchal.V.M. “Machine Drawing”, Charotar Publishing House, 38th Edition, 2003.
2. K.L.Narayana, P.Kannaiah, K.Venkata Reddy, Machine drawing, New Age International, 3rd Ed., 2006.
3. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007
4. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butterworth Heinemann, 2004
5. University of Alberta - ANSYS Tutorials - https://sites.ualberta.ca/~wmoussa/AnsysTutorial/

MTP72	EMBEDDED SYSTEM DESIGN LAB	L	T	P	C
		0	0	3	2
Objectives:	• To introduce system design concepts to students using microcontrollers with foundational concepts of microcontroller architecture and programming. • To introduce hardware and software integration for real time systems using microcontrollers and thereby imparting real time system design knowledge to students.				
Outcomes:	• Understand about Analog to digital converting technique, Pulse with modulation methods, various bus communication techniques, Real time clock and various sensor handling methods. • Have an ability to work in different Operating systems (Copy righted and open source) such as Ubuntu, Rasbian OS, Integrated Development environments, Compilers, Assemblers and programmers. • Develop programs in various platforms such as Embedded C, C++, HTML, DBMS etc., • Develop project with different types of analog and digital sensors.				

List of Experiments

1. Voltage Measurement with display
2. Designing a voltmeter to measure voltage from0to5voltsanddisplayingthe measured value using7 segment displays
3. Design of Real Time Clock using MCS 51 using segment Displays.
4. Design of Water Pump Controller to sense the water level in a tank
5. Digital Clock with LCD display
    a. Temperature Measurement with 7 segment display
6. Implementation of UART, ADC and DAC features
7. Design of Single Channel Data Acquisition System
8. PC Communication
9. Interfacing the microcontroller to a PC through RS232 interface and displaying themessagesentbythemicrocontrolleronthePCusingVisualBasicprogram running in PC
10. Remote Control through FM Link
11. Establishing an FM link between two microcontrollers for data transfers.
12. Hot Chamber Controller to maintain the temperature at the set point.
13. Obstacle Detector using ultrasonic transmitter-receiver
14. Moisture sensor and sprinkler controller design

MTP73	PROJECT PHASE I	L	T	P	C
		0	0	3	4
Objectives:	• To develop knowledge to formulate a real world problem and project's goals • To identify the various tasks of the project to determine standard procedures • To identify and learn new tools, algorithms and techniques • To understand the various procedures for validation of the product and analysis the cost-effectiveness				
Outcomes:	• Formulate a real world problem, identify the requirement and develop the design solutions • Express the technical ideas, strategies and methodologies • Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project				

Details

Project phase I is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental , design or combination of these in the area of Mechatronics Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. The evaluation is based on continuous internal assessment by an internal assessment committee scenarios of embedded systems.

On completion of the Phase I work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal assessment committee for 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.

MTP74	INDUSTRIAL VISITS / TRAINING REPORT	L	T	P	C
		0	0	0	1
Objectives:	• To provide an exposure to students about practical working environment. • To experience the importance of working safely.				
Outcomes:	• Understand how does the product of the plant is interfaced to the world. • Experience the importance of working safety				

Details

During the course of study from 3rd to 7th semester each student is expected to undertake a minimum of four industrial visits or undertake a minimum of two weeks of industry/field training. The students are expected to submit a report, which shall be evaluated by an internal assessment committee at the end of seventh semester for 100 marks.

MTP75	COMPREHENSIVE VIVA VOCE	L	T	P	C
		0	0	3	1
Objectives:	• The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Mechatronics Engineering acquired over 4 years of study in the undergraduate program. • To prepare the students to face interview both at the academic and the industrial sector				
Outcomes:	• Enable the student's learning and understanding during the course of their undergraduate program. • Enriched with academic and industrial skills				

Details

The student will be tested for his understanding of basic principles of the core Mechatronics Engineering subjects. The internal assessment for a total of 50 marks will be made by an internal assessment committee. The committee will conduct two written examinations of objective or short questions type from all the core subjects. The external university examination, which carries a total of 50 marks, will be a Viva Voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

MTT81	AUTOMOTIVE ELECTRONICS	L	T	P	C	Hours
		4	0	0	4	60
Objectives:	• To impart knowledge on the basics of electronics, emission controls and standards in automobiles. • To study the various ignition and injection system • To study the various sensors and actuators used in automobiles for improving fuel economy and emission control. • To study the various blocks of control units used for control of fuel, ignition and exhaust systems • To learn about chassis and vehicle safety systems					
Outcomes:	• Acquire knowledge in emission standards in automobiles. • Understand the electronic fuel injection/ignition components and their function. • Knowledge to choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators. • Diagnose electronic engine control systems problems with appropriate diagnostic tools. • Analyses the chassis and vehicle safety system.					

Unit I Introduction **(12 Hours)**

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits

Unit II Ignition and Injection Systems. **(12 Hours)**

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

Unit III Sensor and Actuators in Automotives **(12 Hours)**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

Unit IV Engine Control Systems **(12 Hours)**

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

Unit V Chassis And Safety Systems **(12 Hours)**

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

Text Books

1. W.H.Crouse, Automotive Mechanics, Tata McGraw Hill Publishing Co., 1995.
2. V.L.Maleev, Internal Combustion Engines, McGraw Hill, 1987.
3. Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2013

References

1. Barry Hollembeak, “Automotive Electricity, Electronics & Computer Controls”, Delmar Publishers, 2001.
2. Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication, 2000.
3. Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 1999.
4. Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers, 2000.
5. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.

MTT82	PROFESSIONAL ETHICS AND INDIAN CONSTITUTION	L	T	P	C
		1	0	0	1
Objectives:	• To enable the students to create an awareness on Engineering Ethics and Human Values • To impart Moral and Social Values and Loyalty and to appreciate the rights of others.				
Outcomes	• Students will have awareness on Engineering Ethics and Human Values • Students will have better understanding on Indian constitution and its values				

The course should cover the following topics by way of Seminars, Expert Lectures and assignments:

1. Engineering Ethics – Moral issues, Ethical theories and their uses
2. Engineering as Experimentation – Code of Ethics
3. Engineer's responsibility for safety
4. Responsibilities and rights
5. Global issues of engineering ethics
6. Fundamental Rights and Constitution of India

References

1. Charles D.Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011

MTP81	PROJECT PHASE II	L	T	P	C
		0	0	12	8
Objectives:	• To develop knowledge to formulate a real world problem and project's goals. • To identify the various tasks of the project and to identify and learn new tools, algorithms and techniques with standard procedures.				
Outcomes:	• Design, analyze, realize / simulate a physical system by using the technology they learnt during the program. • Disseminate his/her work both in oral and written format in a team.				
Project work phase II will be an extension of the project work started in the seventh semester. On completion of the work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal assessment committee for 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.					

MTP82	SEMINAR	L	T	P	C
		0	0	3	1
Objectives:	• To develop the self-learning skills and to utilize various technical resources available from multiple field • To promote the technical presentation and communication skills				
Outcomes:	• Refer and utilize various technical resources available from multiple field • Improve the technical presentation and communication skills				
Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for a total of 100 marks.					

ELECTIVE -I

MTE51	AUTOMOBILE ENGINEERING	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To enable students identify the different parts of the automobile. • To learn working of various parts like engine, transmission, clutch, brakes. • To study how the steering and the suspension systems operate and Students will know the working of various parts like brakes and chassis. • To enable the students know about battery and lighting system • To learn about alternate energy sources in automobiles					
Outcomes	• Identify the IC engine components and its function • Categorize the types of transmission system • Choose appropriate suspension, brake and steering systems for automobile applications • Design the circuit for automotive electrical systems for automobiles • Analyze the use of alternate fuel sources recommended for automobiles					

Unit I Engine Components **(9 Hours**

Components of an Automobile – Engine Terminology – Types of engines: Petrol& Diesel - 2 Stroke and 4 Stroke – Engine components: Cylinder block – Cylinder head – Sump – Manifolds – Gaskets – Cylinder - Piston – Rings – Connecting rod – Piston pins – Crank shaft – Bearings – Valves – Mufflers. Engine cooling and Lubrication systems.

Unit II Transmission Systems **(9 Hours)**

Clutch – Types and Construction – Clutch operation: Electromagnetic – Mechanical – Hydraulic – Vacuum. Gear Boxes: Manual and Automatic – Simple Floor Mounted Shift Mechanism – Over Drives – Transfer Box - Fluid flywheel - Torque converter – Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle – Hotchkiss Drive and Torque Tube Drive.

Unit III Steering, Brakes and Suspension **(9 Hours)**

Wheels and Tyres – Wheel Alignment Parameters. Steering: Steering Geometry - Types of steering gear box – Davis and Ackermann steering mechanism - Power Steering – Electronic Steering. Types of Front Axle. Suspension systems: Types of suspension springs – Plastic, Air and Independent suspension system – Shock absorbers – Active vibration control. Braking Systems: Types and Construction – Hydraulic brakes - Diagonal Braking System – Antilock Braking System.

Unit IV Battery and Lighting System **(9 Hours)**

Types of batteries - Construction, Operation and Maintenance. Electrical systems: Lighting – Wiring circuit - Head lights – Switches – Indicating lights. Accessories: Direction indicators – Windscreen wiper – Horn – Speedometer – Heaters – Air conditioner.

Unit V Alternate Energy Sources **(9 Hours)**

Use of Natural Gas, LPG, Bio diesel, Gasohol and Hydrogen in Automobiles - Electric and Hybrid Vehicles, Fuel Cells. Cost benefit analysis of various alternate energy sources for automobiles.

Text Books

1. Kirpal Singh, - Automobile Engineering‖, 13th Edition, Volume I & II, Standard Publishers, New Delhi, 2012.
2. Ganesan V., - Internal Combustion Engines‖, 4th Edition, Tata McGraw-Hill, New Delhi, 2012

References

1. Crouse William H. and Anglin Donald L., ―Automotive Mechanics‖, 10th Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Heitner Joseph, ―Automotive Mechanics‖, 2nd Edition, East-West Press, New Delhi, 2006.
3. Tom Denton, ―Automobile Electrical and Electronics Systems‖, 4th Edition, Edward Arnold Publishers, 2013.
4. Heinz Heisler, ―Advanced Vehicle Technology‖, 2nd Revised Edition, Butterworth-Heinemann Ltd., 2002.

MTE52	TOTAL QUALITY MANAGEMENT	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To understand the need for total quality management • To enumerate the total quality principles in industries • To learn about the various tools and techniques used in TQM • To know about the quality concepts followed in industries • To understand the benefits of quality and environmental management systems					
Outcomes	• Interpret the need for total quality management • Familiarize on the total quality principles in industries • Familiarize on bench marking and failure mode effect analysis techniques • Understand the performance measure tools and techniques • Understand the quality management tools and environmental management tools					

Unit I Introduction **(9 Hours)**

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

Unit II TQM Principles **(9 Hours)**

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

Unit III TQM Tools And Techniques I **(9 Hours)**

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

Unit IV TQM Tools And Techniques II **(9 Hours)**

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

Unit V Quality Management System **(9 Hours)**

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.

Text Books

1. Kiran D.R, -Total Quality Management: Key Concepts and Case Studies, BS Publications, November 15, 2016.
2. Poornima M. Charantimath, -Total Quality Management, 3rd Edition, Pearson Education April 27, 2017.

3. Panneerselvam, R and Sivasankaran, P, Quality Management , PHI Learning Private Limited, Delhi, 2014

References

1. Williams, M., Griffin, M. and Attaway, J. Observations on quality. Risk Management. October. Pp. 51-52. 2001
2. Douglas, T and Judge, W. Total Quality Management Implementation and Competitive Advantage: The Role of Structural Control and Exploration. Academy of Management Journal. Vol. 44, No. 1. pp. 158. 2001.
3. Agus, A. The Structural Linkages between TQM, Product Quality Performance and Business Performance: Preliminary Empirical Study in Electronic Companies. Singapore Management Review. Vol. 27, No. 1. pp. 87. 2005

MTE53	UNCOVENTIONAL MACHINING PROCESS	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To differentiation between convention and unconventional machining process and need of unconventional machining in the current scenario. • To know about the metal removal rate and surface finish of different materials using mechanical energy based processes • To know about the metal removal rate and surface finish of different materials using electrical energy based processes • To know about the metal removal rate and surface finish of different materials using chemical energy based processes • To know about the metal removal rate and surface finish of different materials using thermal energy based processes					
Outcomes	• Understand the basic principle of conventional machining process • Interpret the mechanical energy based processes • Familiarize on the various electrical energy based processes • Interpret the chemical energy based processes • Familiarize on the various thermal energy based processes					

Unit I Introduction **(9 Hours)**

Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Nontraditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.

Unit II Mechanical Energy Based Processes **(9 Hours)**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

Unit III Electrical Energy Based Processes **(9 Hours)**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications

Unit IV Chemical And Electro-Chemical Energy Based Processes **(9 Hours)**

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters-ECG and ECH - Applications.

Unit V Thermal Energy Based Processes **(9 Hours)**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications

Text Books

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2009
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.

References

1. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Prof Med/Tech, 2005.
2. Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.
3. McGeough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.
4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.
5. Jain V.K., Introduction to Micromachining, Alpha Science International Limited, 2010

MTE54	INTRODUCTION TO FINITE ELEMENT ANALYSIS	L	T	P	C	Hours
		3	0	0	3	45

Objectives	• To introduce the concepts of mathematical modeling of engineering problems. • To provide knowledge on one dimensional elasticity problems • To provide knowledge on two dimensional elasticity problems • To learn about axisymmetric and isoparametric elements • To appreciate the use of FEM to a range of engineering problems
Outcomes	• Comprehend the finite element concepts used for designing engineering components. • Derive the element matrix equation for solving one dimensional structural problems for different applications • Compute the results for a 3D domain using simple two dimensional assumptions for different applications • Solve and analyze the engineering problems using axisymmetric assumptions • Solve and analyze the engineering problems using isoparametric elements for two dimensional continuum

Unit I Introduction **(09 Hours)**

Introduction to finite element analysis – Discretization – Matrix algebra – Gauss elimination method – Governing equations for continuum – Classical Techniques in FEM. Weighted residual method – Ritz method. Potential energy approach – Galerkin approach for one and two dimensions.

Unit II One Dimensional Elasticity Problems **(09 Hours)**

1-D Finite element modeling – Bar Element – Beam Element- Coordinates and shape functions – Assembly of stiffness matrix and load vector –Formulation of Element Matrices and Equations - Analysis of Truss and Beam problems – Applications to Heat Transfer problems.

Unit III Two Dimensional Elasticity Problems **(09 Hours)**

Introduction to 2-D Finite element modeling – Plane stress – Plane Strain – Displacement Equations – Element Matrices – Element Equations – Formulation using Natural Coordinates

Unit IV Axisymmetric Elements **(09 Hours**

Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Rotating discs.

Unit V Isoparametric Elements for Two Dimensional Continuum **(09 Hours)**

Four node quadrilateral elements – Shape functions – Element stiffness matrix and force vector – Numerical integration - Stiffness integration – Stress calculations

Text Books

1. Cook R.D., Malkus D.S., Plesha M.E. and Witt R.J., ―Concepts and Applications of Finite Element Analysis‖, 4th Edition, John Wiley & Sons, 2007.
2. Rao S.S., ―The Finite Element Method in Engineering‖, Butterworth-Heinemann, 2010.

References

1. Logan D.L., ―A First Course in the Finite Element Method‖, 3rd Edition, Thomson Learning, 2011.
2. Reddy J.N., ―An Introduction to the Finite Element Method‖, Tata McGraw Hill, International Edition, 2006.
3. Hutton David V., ―Fundamentals of Finite Element Analysis‖, Tata McGraw-Hill, New York, 2005.
4. Baguley, D. and Hose, D. R. (1994) Why Do Finite Element Analysis , Hamilton, NAFEMS.
5. Monaghan, D. (2002) Using FEA: A Word of Warning [Online]. Available at http://web.archive.org/ web/ 20020328171527/ http://www.dermotmonaghan.com/ fea/htm/ introduction/ word_of_caution.htm (Accessed 21 September 2015).

MTE55	SMART MATERIAL FOR MECHATRONICS	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To provide comparative analysis of different smart materials • To educate the students on piezoelectric materials • To provide knowledge on shape memory alloys • To provide knowledge on application of electro-active polymers • To provide knowledge on applications of magnetostrictive materials for active vibration control					
Outcomes	• Outline the properties and applications of smart materials and Nano materials • Select the Smart Materials for Magneto-Thermo-Mechanical applications • Interpret the usage of shape memory alloys • Interpret the applications of EAP • Familiarize on the applications of magnetostrictive materials					

Unit I Introduction & Nano Materials **(9 Hours)**

Smart materials and their application for sensing and actuation, Mechatronics aspects, properties and applications Nano Materials: Low dimensional structures (quantum dot, wire and well) – Features of nano materials – Synthesis: top down and bottom up approaches – Ball milling and lithographic methods – Physical and chemical vapor phase depositions – Sol gel method.

Unit II Piezoelectric Materials **(9 Hours)**

Piezoelectricity and piezoelectric materials, Constitutive equations of piezoelectric materials, Piezoelectric actuator types, Control of piezoelectric actuators, Applications of piezoelectric actuators for precise positioning and scanning

Unit III Shape Memory Alloys (SMA) **(9 Hours)**

Properties of shape memory alloys, Shape memory effects, Pseudo-elasticity in SMA, Design of shape memory actuator, selection of materials, Smart actuation and control, Applications of SMA in precision equipment for automobiles, trains and medical devices**.**

Unit IV Electro-Active Polymers (EAPS) **(9 Hours)**

Ionic polymer metal composites (IPMC), Conductive polymers, Carbon nanotubes, Dielectric elastomers, Design & control issues for EAP actuators, Applications of EAP for biomemetic, tactile display and medical devices.

Unit V Magnetostrictive Materials **(9 Hours)**

Basics of magnetic properties of materials, magnetostriction: constitutive equations, types of magnetostrictive materials, Design & control of magnetostrictive actuators, Applications of magnetostrictive materials for active vibration control

Text Books

1. 1.Jose L. Pons, Emerging Actuator Technologies, a Micro mechatronics Approach, John Wiley & Sons Ltd, 2005
2. Mel Schwartz, “Smart Materials”, CRC Press New York, 2009
3. M.V. Gandhi and B.S. Thompson, “Smart Materials and Structures”, Chapman & HallUK, 1992.

References

1. Cohen Y. B., Electroactive Polymer (EAP) Actuators as Artificial Muscles Reality, Potential and Challenges, SPIE press, USA, 2004.
2. William D. Callister, “Materials Science and Engineering”: An Introduction, Wiley, 2004.
3. Brian Culshaw, “Smart Structures and Materials”, Artech House, Boston, 2000.

ELECTIVE - II

MTE61	ADDITIVE MANUFACTURING	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies • Usage of CAD & Reverse Engineering concept in Additive Manufacturing • To be familiar with the characteristics of the different materials those are used in Additive Manufacturing. • To be familiar with various rapid prototyping Additive Manufacturing Techniques • Usage of Additive Manufacturing in Bio Products					
Outcomes	• Upon completion of this course, the students can able to compare different method and discuss the effects of the Additive Manufacturing technologies. • Use Latest technologies like CAD Model and Simulation tools and do computer assisted Additive Manufacturing • Analyze the characteristics of the different materials in Additive Manufacturing. • Will learn the latest trends and opportunities in 3D printing, localized • services, production parts • Understand the latest trends and business opportunities in Additive Manufacturing, distributed manufacturing and mass customization.					

Unit I Introduction **(9 Hours)**

Overview – History – Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling – Applications.

Unit II CAD & Reverse Engineering **(9 Hours)**

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Software's for Additive Manufacturing Technology: MIMICS, MAGICS.

Unit III Liquid and Solid Based Additive Manufacturing **(9 Hours)**

Classification – Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing

Unit IV Powder Based Additive Manufacturing Systems **(9 Hours)**

Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

Unit V Bio-Additive Manufacturing & Software's **(9 Hours)**

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies Preparation of Drawings for Parts and Assembly of the following by using Drafting software. Designing for Additive Manufacturing (DfAM), Software Tools vs. Requirements

Text Books

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

References

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

MTE62	MEMS AND NANO TECHNOLOGY	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To impart knowledge about the latest trends in manufacturing micro components and measuring systems to Nano scale. • To provide knowledge on processing techniques of micro-electro mechanical systems • To enumerate the concepts on applications of micro devices • To gain knowledge on the properties of nano materials • To perform characterization study on nano materials					
Outcomes	• Familiarize on MEMS and microsystems • Understand the processing techniques of MEMS • Understand the need for smart materials • Understand the science of nano materials • Familiarize on various characterization tests for nano materials					

Unit I Overview of Mems and Microsystems (9 Hours)

Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication of micro-system, microelectronics, working principle and applications of micro system

Unit II Materials, Fabrication Processes and Micro System Packaging (9 Hours)

Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon pies resistors, Gallium arsenide, quartz, polymers for MEMS,conductive polymers. Photolithography, photo resist applications, light sources, in implantation, diffusion process exudation – thermal oxidation, silicon diode, chemical vapor deposition, sputtering - deposition by epitoxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.

Unit III Micro Devices and Materials (9 Hours)

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measured displacement sensors, pressure and flow sensors, and micro actuators – smart materials – applications.

Unit IV Science of Nano Materials (9 Hours)

Classification of Nano structures – effect of the nanometer length scale effects of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of Nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process.

Unit V Characterization of Nano Materials (9 Hours)

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques –spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

Text Books

1. Zhaoying Zhou, Zhonglin Wang, Liwei Lin "Microsystems and Nanotechnology"- 2012
2. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003

References

1. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
2. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
3. Mark Madou Fundamentals of Micro fabrication, CRC Press, New York, 1997.
4. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.
5. The MEMS Hand book, Mohamed Gad-el-Hak, CRC Press, New York, London.

MTE63	BIOMEDICAL INSTRUMENTATION	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To Introduce Fundamentals of Biomedical Engineering • To study the communication mechanics in a biomedical system with few examples • To study measurement of certain important electrical and non-electrical parameters • To understand the basic principles in imaging techniques • Students will have basic knowledge in life assisting and therapeutic devices					
Outcomes	• Differentiate different bio potentials and its propagations • Illustrate different electrode placement for various physiological recordings • Design bio amplifier for various physiological recordings • Explain various technique for non-electrical physiogical measurements • Demonstrate different biochemical measurement techniques					

Unit I Introduction to Bio-Medical Instrumentation (9 Hours)

Human Physiological Systems: Cell and its structure-Resting and action potentials-Different systems of human body: Skeletal system-Circulatory system-Respiratory system-Excretory system-Central nervous system-Peripheral nervous system. Physiological Transducers: Introduction-Classification of transducers-Displacement, position and motion transducers: Piezo electric transducers-Ultrasonic transducers-Transducers for body temperature measurements: Thermocouples-Electrical resistance Thermometer-Thermistors. Optical fibre sensors.

Unit II Electrical Parameters Acquisition and Analysis (9 Hours)

Bio Potential Electrodes and Bio signal Acquisition: Components of the Bio medical instrument system-Electrodes: Micro electrode-depth and needle electrode-surface electrodes. Amplifiers: Medical preamplifiers-Chopper amplifiers-Isolation amplifier. Biomedical Recorders and Patient Safety: ECG-EEG-EMG-EOG-ERG: Lead systems, recording methods and typical waveforms. Patient safety: Electrical shock hazards-leakage currents-Safety codes for electro medical equipment-Electrical safety analyzer.

Unit III Non Electrical Parameters Measurement and Diagnostic Procedures (9 Hours)

Non Electrical Parameters Measurement and Diagnostic Procedures: Patient monitoring systems: Measurement of heart rate-Blood pressure Measurement- Cardiac output. Pulmonary function analyzers: Pulmonary function measurements - Spirometry. Blood gas analyzers: Blood pH measurement-Measurement of blood pCO2-Blood pO2 measurement. Oximeters: Pulse oximeter.

Unit IV Imaging Modalities and Analysis (9 Hours)

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems – Retinal Imaging – Imaging application in Biometric systems – Analysis of digital images.

Unit V Life Assisting, Therapeutic and Robotic Devices (9 Hours)

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy – ICCU patient monitoring system – Nano Robots – Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

Text Books

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.

References

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

MTE64	INSTRUMENTATION AUTOMOTIVE INDUSTRIES	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To provide knowledge about various techniques used for the measurement of industrial parameters • To provide knowledge on measurement of velocity, displacement, viscosity, temperature using various types of sensors and related circuits • To introduce Force & Torque Measuring Instruments • To introduce Pressure & flow Measuring Instruments • To impart knowledge on measuring of process variables, analytical instrumentation, automatic process controls.					
Outcomes	• Capable to select and use strain measuring instruments • Check various available techniques available and select appropriate to obtain satisfactory task for the parameter to be measured like displacement, Force & Torque • Be acquainted with measurement of Pressure & flows. • Be acquainted with measurement of Level & Temperature of a system • Acquire and Interpret the measurement results and cause of any possible error					

Unit I Introduction and Strain Measurement (9 Hours)

Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system.

Strain Gauge and Strain Measurement: Factors affecting strain measurements, Types of strain gauges, theory of operation of resistive strain gauge, gauge factor, types of electrical strain gauges, strain gauge materials, gauging techniques and other factors, strain gauge circuits and temperature compensation, applications of strain gauges

Unit II Displacement, Forces and Torque Measurement (9 Hours)

Resistive potentiometer (Linear, circular and helical), L.V.D.T., R.V.D.T. and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices and Proximity sensors, Large displacement measurement using synchros and resolvers, Shaft encoders. Load cells and their applications, various methods for torque measurement. Use of torque wrenches.

Unit III Pressure and Flow Measurement (9 Hours)

Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, L.V.D.T. for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration. Differential pressure meter like Orifice plate, Venturi tube, flownozzle, Pitot tube, Rotameter, Turbine flow meter, Electromagnetic flow meter, hot wire anemometer, Ultrasonic flow meter.

Unit IV Level & Temperature Measurement (9 Hours)

Resistive, inductive and capacitive techniques for level measurement, Ultrasonic and radiation methods, Air purge system (Bubbler method).Resistance type temperature sensors – RTD & Thermister, Thermocouples & Thermopiles, Laws of thermocouple – Fabrication of industrial thermocouples – Signal conditioning of thermocouples output - Radiation methods of temperature measurement – Radiation fundamentals – Total radiation & selective radiation pyrometers – Optical pyrometer – Two colour radiation pyrometers

Unit V Digital Data Acquisition systems & control (9 Hours)

Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition. Instrumentation systems. Types of Instrumentation systems. Components of an analog Instrumentation Data – Acquisition system. Multiplexing systems. Uses of Data Acquisition systems. Use of Recorders in Digital systems. Digital Recording systems. Modern Digital Data Acquisition system. Analog Multiplexed operation, operation of sample Hold circuits.

Text Books

1. Industrial Instrumentation & Control by S. K. Singh. TMH Publication
2. Electrical and Electronics Measurement and Instrumentation, By A. K. Shawney, Dhanpatrai & sons publications

References

1. Measurement Systems – Application and Design By E.O. Doebelin, TMH Publication
2. Principles of Industrial Instrumentation, D Patranabis, 3rd edition, Mc Graw hill
3. Mechanical & Industrial Measurements by R. K. Jain, Khanna pub

MTE65	INTERNET OF THINGS	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To understand the fundamentals of Internet of Things • To understand the concept of IoT Architecture & models • To learn about the basics of IoT protocols • To build a small low cost embedded system using Raspberry Pi • To apply the concept of Internet of Things in the real world scenario					
Outcomes	• Analyze various protocols for IoT • Develop web services to access/control IoT devices • Design a portable IoT using Rasperry Pi • Deploy an IoT application and connect to the cloud & Analyze applications of IoT in real time scenario • Design and develop various IoT enabled products					

Unit I Introduction to IoT **(9 Hours)**

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies – IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

Unit II IoT Architecture **(9 Hours)**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture – IoT reference model - Domain model - information model - functional model – communication model - IoT reference architecture

Unit III IoT Protocols **(9 Hours)**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security

Unit IV Building IoT with Raspberry pi &Arduino **(9 Hours)**

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board – Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

Unit V Case studies and Real-world applications **(9 Hours)**

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing – Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

Text Books

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011

References

1. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
2. Qusay F. Hassan ,”Internet of Things A to Z: Technologies and Applications” IEEE Press, 2018
3. Nasreddine Bouhaï, Imad Saleh, “Internet of Things: Evolutions and Innovations”, John Wiley & Sons. 2017.

ELECTIVE - III

MTE71	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To provide knowledge about the basics of process planning concepts • To study about process planning activities • To impart knowledge on costing and estimation • To study about the cost estimation for various products after process planning • To learn about the machining time for various machining operations					
Outcomes	• Acquire knowledge on the basics of process planning • Interpret and prepare process planning activities chart • Analyse and interpret the concept of costing and estimation • Understand and compute the job order cost for different type of shop floor • Analyze and computation of the machining time for various machining operations					

Unit I Introduction to Process Planning **(9 hours)**

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-Production equipment and tooling selection

Unit II Process Planning Activities **(9 hours)**

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

Unit III Introduction to Cost Estimation **(9 hours)**

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges-Calculation of depreciation cost

Unit IV Production Cost Estimation **(9 hours)**

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

Unit V Machining Time Calculation **(9 hours)**

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

Text Books

1. Sinha B.P, "Mechanical estimating and Costing", Tata-McGraw Hill publishing co, 1995.
2. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2003.

References

1. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.
2. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
3. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management" ,Khanna Publishers 1997.

MTE72	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C	HOURS
		3	0	0	3	45
Objectives:	• To understand the various characteristics of Intelligent agents • To learn the different search strategies in AI • To gain knowledge in solving AI problems • To introduce students to the basic concepts and techniques of Machine Learning. • To have a thorough understanding of the Supervised and Unsupervised learning techniques					
Outcomes:	• Familiarize on characteristics Intelligent agents • Interpret on various problem solving methods • Understand AI techniques • Understand Machine learning • Interpret the supervised and unsupervised learning					

UNIT I Introduction **(9 hours)**

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems

UNIT II Problem Solving Methods **(9 Hour)**

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games

UNIT III Knowledge Representation **(9 Hours)**

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

UNIT IV Introduction **(9 Hours)**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT V Linear Models **(9 Hours)**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

Text Books

1. Russell S. and P. Norvig,"Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011
3. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition,Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2015.

References

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach(Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press,2009.
3. William F. Clocksin and Christopher S. Mellish," Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003
4. Tom M Mitchell, ―Machine Learning‖, First Edition, McGraw Hill Education, 2013

MTE73	VIRTUAL INSTRUMENTATION	L	T	P	C	Hours
		3	0	0	3	45
Objectives:	• Introduce the principle, programming technique with instrument interfaces and applications of virtual instruments and to understand the basics of data acquisition are introduced in mechatronics systems.					
Outcomes:	• Study about the basics of data acquisition • Acquiring Knowledge on VI programming techniques • Study about the use of analysis tools with various applications • Understand the evolution, advantages, techniques , architecture and applications of visual instrumentation					

Unit I Review of Virtual Instrumentation **(9 hours)**

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data -flow techniques, graphical programming in data flow, comparison with conventional programming

Unit II Programming Techniques **(9 hours)**

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

Unit III Data Acquisition Basics **(9 hours)**

AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation

Unit IV Common Instrument Interfaces **(9 hours)**

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office &.Industrial applications, Visa and IVI, image acquisition and processing. Motion control.

Unit V Use of Analysis Tools **(9 hours)**

Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.

Text Books

1. Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
2. S. Russell and P. Norvig,”Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2009.

References

1. Gerhard Weiss, “Multi Agent Systems”, Second Edition, MIT Press, 2014
2. M. Tim Jones, “Artificial Intelligence: A Systems Approach(Computer Science)”, Jones and Bartlett Publishers, Inc.; First Edition, 2018
3. Nils J. Nilsson, “The Quest for Artificial Intelligence”, Cambridge University Press, 2009

MTE74	AUTOMATED MATERIAL HANDLING	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To study about the fundamentals of automation in material handling • To provide knowledge on common material handling systems • To impart knowledge on automated material handling systems like RGVS, AGVS, AS/RS, etc., • To provide knowledge on transfer mechanisms, conveyors, part feeding devices, robots in material handling • To discuss various case studies related to automated material handling					
Outcomes	• Acquire knowledge on automation in material handling systems • Acquire knowledge on RGVS, AGVS, AS/RS • Familiarize on robots in material handling • Recognize the automated systems with real time applications • Understand the Principles of work holding devices and apply in real time applications					

Unit I Introduction **(9 hours)**

Introduction to work handling concepts in manufacturing – configuration, symbolic representation, work piece characteristics and their significance, Facilities planning process, Facilities design and diagrams, Storage facilities planning, Materials flow, Activity relationship, Space requirements, Facility lay out – computerized lay outs, Evaluation and selection of alternatives, Defined materials handling, Storage – open and closed storage systems, Bulk loading, Unloading, Shipping and Receiving systems and operations.

Unit II Common Material Handling Equipment's **(9 hours)**

Concepts of Unit Loads, Material handling and Storage equipments operation and selection, Containers, Pallets, Conveyor systems, Industrial trucks, Wagon tipplers, Transporters, Stackers, Reclaimers, Silos & hoppers and their accessories, Ropeways, Ship loaders, Cable cranes, Container handling systems, Electric lifts & Hoists, EOT cranes, Elevators, Material handling equipments in Steel mills, Power plants, Mines, Automobile and Transport 27 CIM-2013 SRM(E&T) Industries, Large scale Constructions etc.,

Unit III Automation of Material Handling **(9 hours)**

Automated feeding arrangements for discrete parts, their design based in work piece requirements, orienting methods, one by one feeding, agonizing, stapling etc., - Feeding continuous material liquids, granules etc., - Automated assembly system, elements, configuration design, details and control – Special feeding mechanisms – Automated inspection and their design

Unit IV Classification of Automated Systems **(9 hours)**

Concepts of Unit Built Machines (UBM) – classification and elements, Power Units, self-contained and separate feed type, Change over UBMs, Transfer lines – classification and their components, Automated systems for handling and transfer of prismatic, axis symmetric parts and asymmetric parts in transfer lines, Case studies on transfer lines – interlocked, palletized and flexible inter linkage transfer lines, control systems – SWARF handling and disposal systems.

Unit V Automated Material Handling Equipment's (9 hours)

Automated handling and storage systems in manufacturing environment, Rail Guided Vehicles (RGVs), Automated Guided Vehicles (AGVs), Applications of RGVs and AGVs, Automated Storage a Retrieval Systems (AS / RS), AS / RS in the Automated factory, Considerations for planning an AS /RS system, Applications of AS / RS, Principles of work holding devices – Modular fixturing, Flexible fixturing systems – Fixturing for FMS, Robots and their applications in handling and storage.

Text Books

1. Groover. M. P., 'Automation, Production Systems and CIM, Prentice Hall, 2008
2. Ray Asfahl. C., 'Robots and Manufacturing Automation', 2nd edition, John Wiley & Sons

References

1. Morris A. Cohen, Uday M. Apte., 'Manufacturing Automation', Irwin, Chicago, 1997.
2. James A. Tompkins., 'Facilities planning', John wiley&SonsInc, 2010.
3. James. M. Apple, 'Principles of layout and material handling', Ronald press, 1977.

MTE 75	INTELLIGENT CONTROL SYSTEM	L	T	P	C	Hours
		3	0	0	3	45
Objectives:	• Intelligent control is a class of control techniques that use various artificial intelligence computing approaches like neural networks, Bayesian probability, fuzzy logic, machine learning, reinforcement learning, evolutionary computation and genetic algorithms.					
Outcomes:	• Learn basics of fuzzy set theory and neural networks, Implement fuzzy based decision making systems, Implement Neural Network based approximator , Design Fuzzy and Neural Network based control system					

Unit I Introduction **(9 Hours)**

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems**.**

Unit II Artificial Neural Networks **(9 Hours)**

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller

Unit III Genetic Algorithm **(9 Hours)**

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.

Unit IV Fuzzy Logic System **(9 Hours)**

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

Unit V Applications **(9 Hours)**

GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controllerusing Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

Text Books

1. Padhy.N.P. (2005), Artificial Intelligence and Intelligent System, Oxford University Press.
2. Kosko,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.

References

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 2006.
3. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers 1996.

ELECTIVE - IV

MTE76	AVIONICS	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To introduce the basic of avionics and its need • To study about digital avionics architecture and various avionics data buses • To impart knowledge about the control and display technology • To gain more knowledge on navigation system • To study about the concepts of air data systems and auto pilot					
Outcomes	• Acquaint knowledge on basics of avionics • Ability to build digital avionics architecture • Ability to design Navigation system • Analyze the performance of various cockpit display technologies • Ability to design and perform analysis on air system.					

Unit I Introduction to Avionics **(9 Hours)**

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories

Unit II Digital Avionics Architecture **(9 Hours)**

Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629**.**

Unit III Flight Decks and Cockpits **(9 Hours)**

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

Unit IV Introduction to Navigation Systems **(9 Hours**

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

Unit V Air Data Systems and Auto Pilot **(9 Hours)**

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

Text Books

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., (9th edition) 2015
2. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall,(2nd edition)2006

References

1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
2. Pallet. E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
3. Spitzer, C.R. "Digital Avionics Systems", The Blackburn Press; (2ndedition) October 1, 2000.
4. Spitzer. C.R. "The Avionics Hand Book", CRC Press; (3rd edition)September 3,2014.

MTE77	QUALITY CONTROL AND RELIABILITY	L	T	P	C	HOURS
		3	0	0	3	45
Objectives:	• To introduce the concept of statistical quality control • To understand process control and acceptance sampling procedure and their application • To learn the concept of sampling • To study about the life testing • To impart knowledge about quality and reliability					
Outcomes:	• Summarize the concept of quality and process control for variables • Apply the process control for attributes • Interpret the concept of sampling and to solve problems • Understand the concept of life testing • Acquaint knowledge on reliability and quality techniques involved					

Unit I Introduction and Process Control for Variables **(9 Hours)**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart –X chart, R chart and chart - process capability – process capability studies and simple problems. Six sigma concepts

Unit II Process Control for Attributes **(9 Hours)**

Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

Unit III Acceptance Sampling **(9 Hours)**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

Unit IV Life Testing – Reliability **(9 Hours)**

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

Unit V Quality and Reliability **(9 Hours)**

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development–Product life cycles.

Text Books

1. Douglas's. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley 2012.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 2005

References

1. Besterfield D.H., “Quality improvement”, Prentice Hall,(9th edition) 2013.
2. Connor, P.D.T.O., “Practical Reliability Engineering”, John Wiley, 2012
3. Danny Samson, “Manufacturing & Operations Strategy”, Prentice Hall, 1991
4. Grant, Eugene .L “Statistical Quality Control”, McGraw-Hill, 2017
5. Gupta. R.C, “Statistical Quality control”, Khanna Publishers, (9th edition) 2012.

MTE78	DIGITAL IMAGE PROCESSING AND MACHINE VISION	L	T	P	C	Hours
		3	0	0	3	45
Objectives:	• To become familiar with digital image fundamentals • To get exposed to simple image enhancement techniques in Spatial and Frequency domain. • To learn concepts of degradation function and restoration techniques • To study the image segmentation and representation techniques • To become familiar with image compression and recognition methods					
Outcomes:	• Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms • Operate on images using the techniques of smoothing, sharpening and enhancement. • Understand the restoration concepts and filtering techniques. • Learn the basics of segmentation, features extraction, compression and recognition methods for color models.					

Unit I Digital Image Fundamentals **(9 Hours)**

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT

Unit II Image Enhancement **(9 Hours)**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

Unit III Image Restoration **(9 Hours)**

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Unit IV Image Segmentation **(9 Hours)**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm**.**

Unit V Machine Vision Fundamentals **(9 Hours)**

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology.

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson,(4th edition) 2018.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson,(1st edition) 2015.

References

1. Kenneth R. Castleman, 'Digital Image Processing', Pearson,(2nd edition) 2008.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., (2nd edition) 2017.
3. D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, (1st edition) 1983
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, (4th edition) 2007.
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Cengage India Private Limited, 4th edition,2017.

MTE79	AUTONOMOUS MOBILE ROBOTS	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• Students will learn about basics of robots, programming and machine vision applications in robots					
Outcomes	• Express the basic concepts, laws, components and parameters of robots • Explain the types of grippers and its functions. • Evaluate the kinematic calculations and apply Lagrangian and Newton-Euler methods to analyze dynamic characteristics of robots • Describing the various programming techniques used in industrial robots • Basis of machine vision and apply the concept of image processing					

Unit I Basics of Robotics **(9 Hours)**

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space-accuracy-resolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives.

Unit II Robot End Effectors **(9 Hours)**

Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers.

Unit III Robot Mechanics **(9 Hours)**

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

Unit IV Robot Programming **(9 Hours)**

Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots.

Unit V Machine Vision Fundamentals **(9 Hours)**

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology.

Text Books

1. Groover M.P., M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012
2. John.J. Craig, " Introduction to Robotics: Mechanics &control"Pearson Publication, Fourth edition, 2018

References

1. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2ndEdition, 2010
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.
3. SathyaRanjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, (2nd edition) 2017.

MTE 710	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C	Hours
		3	0	0	3	45
Objectives:	• To study about the importance of product design and customer understanding • To gain knowledge on concept generation and selection criteria in product design and development • To learn about the product architecture • To conduct investigation on industrial design • To study about the principles for design for manufacturing and product development					
Outcomes:	• Familiarizing the product design principles • Understand the principles of concept generation and selection • Understand product architecture • Assess the quality of industrial design • Understand the principles for design for manufacturing and product development					

Unit I Introduction **(9 Hours)**

Need for IPPD – 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.

Unit II Concept Generation and Selection **(9 Hours)**

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

Unit III Product Architecture **(9 Hours)**

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.

Unit IV Industrial Design **(9 Hours)**

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 of 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.

Unit V Design for Manufacturing and Product Development **(9 Hours)**

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**.**

Text Books

1. Kari T.Ulrich and Steven D.Eppinger,"Product Design and Development", McGraw-Hill International Edns. (5^{th} edition) 2017.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Home wood, 1992, ISBN 1-55623-603-4.

References

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

ELECTIVE – V

MTE81	NON-DESTRUCTIVE TESTING METHODS	L	T	P	C	Hours
		3	0	0	3	45
Objectives:	• To study about basics of NDT • To provide basic understanding on surface NDE methods • To impart knowledge on thermography testing • To introduce students to a variety of practical applications associated with ultrasonic testing • To get familiarized with radiography (RT)					
Outcomes:	• Acquire knowledge about non destruction testing methods. • Students will have a basic knowledge of surface NDE techniques which enables them to carry out various inspections with standard procedures. • Students will be able to have a basic knowledge of ultrasonic testing which enables them to perform inspection of samples. • Students will have a complete theoretical and practical understanding of the radiographic testing, interpretation and evaluation.					

Unit I Overview of NDT **(9 Hours)**

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

Unit II Surface NDE Methods **(9 Hours)**

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

Unit III Thermography and Eddy Current Testing (ET) **(9 Hours)**

Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications.Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation

Unit IV Ultrasonic Testing (UT) and Acoustic Emission (AE) **(9 Hours)**

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications

Unit V Radiography (RT) **(9 Hours)**

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography

Text Books

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House,3rd revised edition, 2014.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010

References

1. ASM Metals Handbook,”Non-Destructive Evaluation and Quality Control”,ASM international , 9th edition,1989.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York,2nd edition, 2012.
4. ASNT, American Society for Non-Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing

MTE82	MAINTENANCE ENGINEERING AND CONDITIONING MONITORING	L	T	P	C	Hours
		3	0	0	3	45

Objectives:

- To enable the student to understand the principles and functions of maintenance planning.
- To impart the policies and practices adapted in industry for the successful management of maintenance activities.
- To illustrate some of the simple instruments used for condition monitoring in industry
- To study about the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To study about the repair of material handling equipment.

Outcomes:

- Acquaint knowledge on basics principle of maintenance planning
- To implement the maintenance function and different practices in industries for the successful management of maintenance activities
- To identify the different maintenance categories like Preventive maintenance, condition monitoring
- Understand the repair concepts of simple machine elements.
- Select appropriate repair tool to characterize the material handling equipment.

Unit I Principles and Practices of Maintenance Planning (9 Hours)

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics

Unit II Maintenance policies - Preventive Maintenance (9 Hours)

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle – Principles and methods of lubrication – TPM.

Unit III Condition Monitoring (9 Hours)

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

Unit IV Repair Methods for basic Machine Elements (9 Hours)

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

Unit V Repair Methods for Material Handling Equipment (9 Hours)

Repair methods for Material handling equipment – Equipment records –Job order systems -Use of computers in maintenance

Text Books

1. Srivastava S.K., “Industrial Maintenance Management”, – S. Chand and Co., 2002.
2. Venkataraman .K “Maintenance Engineering and Management”, PHI Learning, Pvt. Ltd., 2007

References

1. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 1995
2. Garg M.R., “Industrial Maintenance”, S. Chand & Co., 2010.
3. Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill, 6th Edition, 2001.
4. Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 1998.
5. Advances in Plant Engineering and Management”, Seminar Proceedings – IIPE, 1996.

MTE83	ADVANCED SENSORS AND NETWORKING	L	T	P	C	Hours
		3	0	0	3	45
Objectives:	• To study and understand the various sensor and its application.					
Outcomes:	• Interpret the basic concepts of sensors and its characteristics demonstrate the Advanced concepts of chemical sensors • Analyze the characteristics of optic sensor measurement system • Explain the concepts, network architectures and applications of wireless sensor networks • Analyze the protocol design issues of wireless sensor networks • Students will have a complete theoretical and practical understanding of the radiographic testing, interpretation and evaluation.					

Unit I Introduction to Sensors **(9 Hours)**

Introduction –Sensor Classification – Sensor Characteristics and Terminology – Physical Effects Employed for Signal Transduction – Mathematical Model of Transducer – Zero, I and II order transducers – Choice of Sensor – New Sensor Materials and Technologies – Standards, Temperature Scales and Units and relations of physical quantities.

Unit II Chemical Sensors **(9 Hours)**

Molecular Recognition – Signal Transduction – Electrochemical Sensors: Amperometric and Voltammetric Sensors – Potentiometric Sensors – Evanescent wave Sensors – Multisensory Arrays – Biosensors – Humidity Sensors

Unit III Optic Sensors **(9 Hours)**

Fundamentals of light – Electromagnetic Optics Spectrum – Propagation of light Lambert – Beer Law – Interactions of Light: Absorption, Scattering, Dispersion, Polarization, Diffraction and Interference – Optical Sources – Optical Detectors – Optical Components – Fiber Optic Sensors: Intensity Modulated Sensors – Diffraction Grating Sensors – Interferometric Sensors

Unit IV Fundamentals of Wireless Communication **(9 Hours)**

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel - wireless sensor networks (WSNs): concepts and architectures. Design Challenges in Sensor Networks

Unit V Wireless Sensor Networks (WSNs) **(9 Hours)**

Single node architecture: hardware and software components of a sensor node - WSN Network architecture: - data relaying and aggregation strategies - Issues in WSN routing–OLSR–Localization–Indoor and Sensor Network Localization-absolute and relative localization. QOS in WSN – Energy Efficient Design.

Text Books

1. John Vetelino and AravindReghu, ―Introduction to Sensors‖, CRC Press, 2010.
2. Francis To So Yu and Shizhuo Yin, ―Fiber Optic Sensors‖, CRC Press, 2008.
3. Holger Karl and Andreas Willig ―Protocols and Architectures for Wireless Sensor Networks‖, Wiley, 2005

References

1. Jacob Fraden, ―Handbook of Modern Sensors‖, Springer, 2010
2. Jirı Janata, ―Principles of Chemical Sensors‖, Springer, 2009.
3. PavelRipka and AloisTipek, ―Modern Sensors Handbook‖, ISTE Ltd, 2007
4. Jon S. Wilson, ―Sensor Technology Handbook‖, Newnes, 2005.
5. KazemSohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks-Technology, Protocols, and Applications‖, John Wiley, 2007.

MTE84	INDUSTRIAL ELECTRONIC AND APPLICATIONS	L	T	P	C	Hours
		3	0	0	3	45
Objectives:	• To learn industrial electronics in applied manner with perspective of mechanical engineering. • To introduce the design philosophy for mechanical processes control based on analog and digital electronics and electrical machines.					
Outcomes:	• To learn industrial electronics in applied manner with perspective of mechanical engineering. • To introduce the design philosophy for mechanical processes control based on analog and digital electronics and electrical machines.					

Unit I Amplifiers **(9 Hours)**

DC Amplifiers: Need for DC amplifiers, DC amplifiers – Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers – Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

Unit II Regulators **(9 Hours)**

Regulated Power Supplies: Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques – Short Circuit, Over voltage and Thermal Protection. Switched Mode & IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators – Current boosting .

Unit III SCR and Thyristor **(9 Hours)**

SCR and Thyristor: Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors – Classes A, B, C, D, E and F, Ratings of SCR

Unit IV SCR in Power Control **(9 Hours)**

Applications of SCR in Power Control: Static circuit breaker, Protection of SCR, Inverters – Classification, Single Phase inverters, Converters –single phase Half wave and Full wave. DIAC, TRIAC and Thyristors Applications: Chopper circuits – Principle, methods and Configurations, DIAC AND TRIAC, TRIACS – Triggering modes, Firing Circuits, Commutation.

Unit V Industrial Applications **(9 Hours)**

Industrial Applications – I: Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital timers, Time base Generators. Electric Welding Classification, types and methods of Resistance and ARC wielding, Electronic DC Motor Control.

Industrial Applications – II: High Frequency heating – principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating – principle, material properties, Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics – Generation and Applications.

Text Books

1. Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
2. Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972.

References

1. Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6th Edn., 2003.
2. Thyristors and applications – M. Rammurthy, East-West Press, 1977.3.
3. Integrated Circuits and Semiconductor Devices – Deboo and Burroughs, ISE

MTE85	CYBER PHYSICAL SYSTEM	L	T	P	C	Hours
		3	0	0	3	45

Objectives:	• To introduce the basic concepts of cyber physical system • To study about the various automated control design • To impart knowledge on modeling and analysis of advanced automata • To provide knowledge on hybrid automata modeling • To perform various case studies on CPS
Outcomes:	• Understand the basic concepts of cyber physical system • Acquire knowledge on automated control design • Acquire knowledge on modelling and analysis on advanced automata • Understand on hybrid automata modelling • Interpret the various case studies on cyber physical system

Unit I Introduction **(9 Hours)**

Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, CPS HW platforms: Processors, Sensors, Actuators, CPS Network, CPS SW stack RTOS, Scheduling Real Time control tasks.

Unit II Stability Analysis: **(9 Hours)**

Principles of Automated Control Design: Dynamical Systems and Stability, Controller Design Techniques CLFs, MLFs, stability under slow switching, Performance under Packet drop and Noise. CPS : From features to software components, Mapping software components to ECUs

Unit III Advanced Automata based modelling and analysis **(9 Hours)**

Basic introduction and examples ,Timed and Hybrid Automata, Definition of trajectories, zenoness, Formal Analysis: Flow pipe construction, reachability analysis, Analysis of CPS Software, Weakest Pre-conditions, Bounded Model checking

Unit IV Hybrid Automata Modelling **(9 Hours)**

Flowpipe construction using Flowstar, SpaceX and Phaver tools, CPS SW Verification: Frama-C, CBMC, Secure Deployment of CPS : Attack models, Secure Task mapping and Partitioning, State estimation for attack detection

Unit V Automotive Case study , CPS Performance Analysis **(9 Hours)**

Vehicle ABS hacking, Power Distribution Case study: Attacks on Smart grid. effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, Formal Methods for Safety Assurance of Cyber-Physical Systems

Text Books

1. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
2. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.
3. T. D. Lewis "Network Science: Theory and Applications", Wiley, 2009.
3. P. Tabuada, "Verification and control of hybrid systems: a symbolic approach", Springer-Verlag 2009.

References

1. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer 2007.
2. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing", Wiley publisher, 1996.

ELECTIVE - VI

MTE86	DATA COMMUNICATION AND NETWORKING	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To introduce the fundamental various types of computer networks. • To demonstrate the TCP/IP and OSI models with merits and demerits. • To explore the various layers of OSI Model. • To introduce UDP and TCP Models.					
Outcomes	• Students should be understand and explore the basics of Computer Networks and Various Protocols. • Acquaint knowledge to understand the World Wide Web concepts. • Students should be understand to administrate a network and flow of information further he/she can understand easily the concepts of network security, Mobile and networks.					

Unit I Data Communications **(9 Hours)**

Components – Direction of Data flow – Networks – Components and Categories – Types of Connections – Topologies –Protocols and Standards – ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN Physical layer: Transmission modes, Multiplexing, Transmission Media, Switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.

Unit II Data Link Layer **(9 Hours)**

Introduction, Framing, and Error – Detection and Correction – Parity – LRC – CRC Hamming code, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols. 111 Medium Access sub layer: ALOHA, CSMA/CD, LAN – Ethernet IEEE 802.3, IEEE 802.5 – IEEE 802.11, Random access, Controlled access, Channelization.

Unit III Network Layer **(9 Hours)**

Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Uni-Cast Routing Protocols, Multicast Routing Protocols.

Unit IV Transport Layer **(9 Hours**

Process to Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS, Integrated Services, Differentiated Services, QoS in Switched Networks

Unit V Application Layer **(9 Hours)**

Domain name space, DNS in internet, electronic mail, SMTP, FTP,WWW, HTTP, SNMP

Text Books

1. Data Communications and Networking, Behrouz A. Forouzan , Fourth Edition TMH, 2006.
2. Computer Networks, Andrew S Tanenbaum, 4th Edition. Pearson Education, PHI.

References

1. Data communications and Computer Networks, P.C .Gupta, PHI.
2. An Engineering Approach to Computer Networks, S. Keshav, 2nd Edition, Pearson Education.
3. Understanding communications and Networks, 3rd Edition, W.A. Shay, Cengage Learning.

MTE87	NON-CONVENTIONAL ENERGY SOURCES	L	T	P	C	HOURS
		3	0	0	3	45
Objectives:	• To introduce the basics of NCES and statistical data on conventional energy resources. • To study about the concept of solar energy and its types • To learn the wind energy conversion systems • To provide knowledge on geothermal energy resources and biomass energy conversion systems • To impart knowledge about tidal, wave and OTEC energy power generation system					
Outcomes:	• Acquaint knowledge on basics of NCES • Acquire knowledge on the solar energy and its conversion systems. • Understand the concepts of Wind energy conversion systems • Analyze harnessing of Geothermal, Ocean energies. • Recognize the need and ability to engage in lifelong learning for further developments in this field.					

Unit I Statistics on Conventional Energy Sources **(9 Hours)**

Statistics on conventional energy sources and supply in developing countries, Definition Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES – Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

Unit II Solar Energy **(9 Hours)**

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

Unit III Wind Energy **(9 Hours)**

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion – Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle

Unit IV Geothermal Sources **(9 Hours)**

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features Atmospheric exhaust and condensing, exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Constructional details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs

Unit V Wave, Tidal and OTEC Energy **(9 Hours)**

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

Text Books

1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 5th edition, 2011.
2. K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi, 2003.

References

1. Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004
2. Wakil MM, Power Plant Technology, McGraw Hill Book Co, New Delhi, 2004.
3. Non – Conventional Energy Sources.G.D. Rai, Khanna Publishers,4th edition , 2009

MTE88	COMPOSITE MATERIALS AND STRUCTURES	L	T	P	C	Hours
		3	0	0	3	45
Objectives:	• To study about the basic concepts of composite materials • To impart knowledge about macro mechanics • To make the student understand the analysis of composite laminates under different loading conditions and different environmental conditions. • To study about the fabrication process and repair methods • To learn about the design concepts of sandwich construction					
Outcomes:	• Understand the basics of composite materials • Understanding the mechanics of composite materials • Ability to analyse the laminated composites for various loading eases • Acquaint knowledge in manufacture of composites • Interpret design concepts of sandwich construction					

Unit I Micromechanics **(9 Hours)**

Introduction – advantages and application of composite materials – types of reinforcements and matrices – micro mechanics – mechanics of materials approach, elasticity approach- bounding techniques – fiber volume ratio – mass fraction – density of composites. effect of voids in composites.

Unit II Macro mechanics **(9 Hours)**

Generalized Hooke's Law – elastic constants for anisotropic, orthotropic and isotropic materials – macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis – determination of in plane strengths of a lamina – experimental characterization of lamina. failure theories of a lamina. hygrothermal effects on lamina.

Unit III Laminated Plate Theory **(9 Hours)**

Governing differential equation for a laminate. Stress – strain relations for a laminate. Different types of laminates. in plane and flexural constants of a laminate. hygrothermal stresses and strains in a laminate. failure analysis of a laminate. Impact resistance and inter-laminar stresses. netting analysis

Unit IV Fabrication Process and Repair Methods **(9 Hours)**

Various open and closed mould processes, manufacture of fibers, importance of repair and different types of repair techniques in composites – autoclave and non-autoclave methods.

Unit V Sandwich Constructions **(9 Hours)**

Basic design concepts of sandwich construction – materials used for sandwich construction – failure modes of sandwich panels – bending stress and shear flow in composite beams.

Text Books

1. Dam Ishai., "Mechanics of Composite Materials,"
2. Isaac M. Daniel, "Mechanics of Composite Materials,"2006
3. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2nd edition, 2006.
4. Madhuji Mukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2005

References

1. Agarwal, B.D., and Broutman, L.J., “Analysis and Performance of Fibre Composites,” John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., “Handbook on Advanced Plastics and Fibre Glass”, Von Nostrand Reinhold Co., New York, 1989.
3. Calcote, L R. “The Analysis of laminated Composite Structures”, Von – Nostrand Reinhold Company, New York 1989.
4. Allen Baker, “Composite Materials for Aircraft Structures”, AIAA Series, III Edition, 2016.

MTE89	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C	Hours
		3	0	0	3	45
Objectives	• To introduce about the basics of entrepreneurship • To study about various generation of ideas • To impart awareness on various legal aspects of business • To provide knowledge on business finance • To learn about operation management and decisions					
Outcomes	• Understand the basics of entrepreneurship • Acquire knowledge on various generation of ideas • Understand the legal aspects of business • Students will be able to understand the finance criteria. • Interpret the strategies for successful implementation of ideas					

Unit I Basics of Entrepreneurship **(9 Hours)**

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

Unit II Generation of Ideas **(9 Hours)**

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractionation, Reversal Method, Brain Storming, Analogies

Unit III Legal Aspects of Business **(9 Hours)**

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

Unit IV Business Finance **(9 Hours)**

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, and cash flow analysis.

Unit V Operations Management **(9 Hours)**

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Text Books

1. Entrepreneurship Development, A. Nirjar, Sanbun Publishers, 2011
2. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi:5th edition, 2005.
3. Entrepreneurial Development, S.S.Khanka S. Chand Publishing, 2006

References

1. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi:5th edition, 2005.
2. AkhileshwarPathak, Legal Aspects of Business, Tata McGraw Hill:7th edition, 2018.

MTE 810	AUTOMATED INSTRUMENTATION AND EMBEDDED SYSTEMS	L	T	P	C	Hours
		3	0	0	3	45

Objectives:

- To make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.
- To explore the various types of analyzers used in industrial applications.
- To introduce the Building Blocks of Embedded System
- To Educate in Various Embedded Development Strategies
- To Introduce Bus Communication in processors, Input/output interfacing

Outcomes:

- Understand the instrumentation behind flow, level, temperature and pressure measurement
- Acquire basic knowledge on the various types of analyzers used in typical industries.
- Acquire a basic knowledge about fundamentals of microcontrollers, programming and system control to perform a specific task.
- Acquire knowledge about devices and buses used in embedded networking.
- Develop programming skills in embedded systems for various applications

Unit I Measurement of Process Parameters (9 Hours)

Review the various Measurement techniques of temperature, pressure, flow and level – application - selection of sensors– calibration methods.

Unit II Instruments for Analysis (9 Hours)

Ion selective electrodes: Gas & Liquid Chromatography - Oxygen analyzers for gas and liquid – CO, CO2, NO and SO Analyzers- Hydrocarbon and HS Analyzers – Dust Analyzers, smoke Analyzers, Toxic gas Analyzers and radiation monitoring.

Introduction to Safety Instrumented Systems – Hazards and Risk – Process Hazards Analysis (PHA) – Safety Life Cycle – Control and Safety Systems

Unit III Introduction to Embedded Systems (9 Hours)

Brief overview of real time systems and embedded systems - Classification of embedded systems - Embedded system definitions - Functional and non-functional requirements - Architectures and standards - Typical applications..

Unit IV Embedded System Components and Interface (9 Hours)

Device choices - Selection criteria and characteristics of Processors and memory systems for embedded applications - Interface and Peripherals - Power sources and management.

Unit V Embedded System Design and Development (9 Hours)

Design methods and techniques - Classification of need - Need analysis -Requirement and specification - Conceptual design - Models and languages – State machine model - State machine tables - Verification – Validation - Simulation and emulation.

Text Books

1. B.G.Liptak, “Instrumentation Engineers Handbook (Process Measurement & Analysis)”, Fourth Edition, Chilton Book Co, CRC Press, 2005.
2. Noergaard, T., “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Elsevier Publications, 2005.
3. Berger, A.S., “Embedded System Design: An Introduction to Process, Tools and Techniques”, CMP Books, 2002.

References

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