Department of Mechatronics Engineering

Minutes of Second Board of Studies Meeting

The second Board of Studies meeting of Mechatronics Engineering Department was held on 1st April 2021 at 2:00 P.M in the R&D Lab, Sri Manakula Vinayagar Engineering College, with the Head of the Department in the Chair.

The following members were present for the BoS meeting

Sl.No	Name of the Member with Designation and official Address	MEMBERS AS PER UGC NORMS
1	**Dr. G. Balamuruga Mohan Raj** Professor and Head Department of Mechatronics Engineering, SMVEC	Chairman
2	**Dr.Shankar Krishnapillai,** Professor, Indian Institute of Technology, Chennai – 600 036.	Subject Expert (University Nominee)
3	**Dr.D.Dinakaran,** Professor, Hindustan Institute of Tech. & Science, Chennai – 103	Subject Expert (Academic Council Nominee)
4	**Dr.R.Parameshwaran,** Professor, Kongu Engineering College, Erode – 638 606	Subject Expert (Academic Council Nominee)
5	**Mr.P.Ramesh** Managing Director, Switching Technologies Gunther Ltd., Tambaran, Chennai – 600045	Representative from Industry
6	**Dr. A.G.Ganesh Kumar, M.E., Ph.D** Professor/Mechanical	Internal Member
7	**Prof. P. Ramesh Kumar, M.E,** Assistant Professor/Mechatronics	Internal Member
8	**Dr. R. Kurinjimalar, M.E., Ph.D.,** Associate Professor/ECE	Internal Member

9	**Prof. Pushaparaj, M.E.** Assistant Professor/ECE	Internal Member
10	**Prof. N. Vijayan** Assistant Professor / Mathematics	Internal Member
11	**Dr. A. Rajappa** Associate Professor / Chemistry	Internal Member
12	**Dr. M. A. Ishrath Jahan** Associate Professor / English	Internal Member
13	**Dr. T. Sivaranjani** Associate Professor / Physics	Internal Member

Agenda of the Meeting

1) Confirmation of minutes of first BoS meeting and the Curriculum Structure of B.Tech Mechatronics Engineering of R-2019 and R-2020 Regulations – Modifications if any.
2) Discuss about the curriculum Structure of B.Tech – Mechatronics Engineering
3) To discuss and approve the proposed B.Tech. Degree Curriculum, syllabi of V and VI semesters under for the B.Tech – Mechatronics Engineering and the students admitted in the Academic Year 2019-20 (Second Year)
   - Course structures
   - Professional Core Courses
   - Professional Elective Courses
   - Open Electives offered to other departments
4) To discuss and approve the B.Tech. Degree Curriculum and Syllabi of V and VI semesters for the B.Tech – Mechatronics Engineering and the students admitted in the Academic Year 2020-21. (First Year)
   - Course structures
   - Professional Core Courses
   - Professional Elective Courses
   - Open Electives offered to other departments

5) To discuss and approve the revised Vision, Mission, Programme Educational Objectives and Programme Specific Outcomes of the department.
6) To discuss about the uniqueness of the Curriculum (R-2020)
   - Employability Enhancement Course
   - Skill Development Courses- Foreign language /IELTS ϖ NPTEL/MOOC Courses
   - Indian Constitution, Essence of Indian traditional knowledge etc are introduced as Mandatory courses

- Statistical laboratory

7) To discuss about the Innovative Teaching / Practices Methodology adopted to handle the emerging / Advanced Technological concept courses.
8) Any other item with the permission of chair.

Minutes of the Meeting

Dr. G. Balamuruga Mohan Raj, Chairman, BoS opened the meeting by welcoming and introducing the external members, to the internal members and the meeting thereafter deliberated on agenda items that had been approved by the Chairman.

Item:1

Chairman, BoS, appraised the minutes of Ist BoS, its implementation and then it is confirmed with the approval for the incorporation of minor revisions needed as mentioned below.

- The subject "Design of Machine elements" is to be included.
  - ✓ The subject "Design of Mechanical elements" is included in Semester-VI
- The Subject "Operations Research" may be kept as an Elective Subject.
  - ✓ The Subject "Operations Research" is kept as Professional Electives in curriculum 2019
- "Metal machining" topic to be added in the subject "Manufacturing Technology".
  - ✓ The topic 'Metal Machining' is included in Semester-II subject 'Manufacturing Technology'
- 3D Printing Practices may be included in Skill Development Courses.
  - ✓ It is kept as one of the skill development course.

The above corrections are approved by BoS members and the details are given in Annexure- I.

Item:2

The curriculum structure of Mechatronics Engineering has been discussed.

The BoS members suggested that VLSI and Embedded system design subject can be split and taught as two different subjects and the details are given in Annexure- II.

Item:3

Recommended to the Academic Council with following suggestions in the Curriculum and Syllabus of Regulation 2019.

Sl. No.	Subject / General Points	Comments
1	*Control System for Mechatronics	Fifth unit may be modified related to mechatronics.
2	Thermal Engineering and Heat Transfer	Laboratory oriented topics may be removed from 3rd and 4th units because the concept is repeated in practical also and the unit is vast.
3	*Microprocessors and Controllers	PLC may be included
4	*CNC and Metrology	Basic concepts of Metal Cutting from 1st unit may be removed. Second unit may be divided into two units. Third unit may be removed because the concept is repeated

			in practical. Measurement methods of surface, screw thread and gear profile.

Item:4 Recommended to the Academic Council with following suggestions in the Curriculum and Syllabus of Regulation 2020.

Sl. No.	Subject / General Points	Comments
1	*Operations Research	The inventory analysis may be included instead of theory of games Replacement analysis may be included as unit five
2	*Design of Mechanical Elements	Design of bevel and worm gears are to be removed
3	*Industrial Robotics Lab	Latest simulation software can be used
4	General point	Eliminate the Brand name of software in any ware in the curriculum and syllabus

***The Courses are common for both R2019 and R2020 Regulations.**

The above corrections are incorporated and the Syllabi (Given in Annexure III) are approved by the BoS members

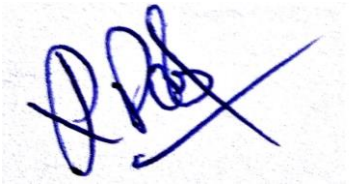
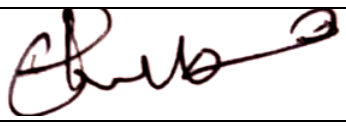
Item:5 The Vision, Mission, Programme Educational Objectives and Programme Specific Outcomes of Mechatronics Engineering department are revised, have been presented in the second BoS meeting. **It was approved by BoS members and given in Annexure- IV.**

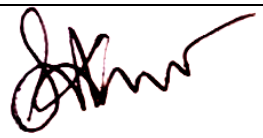
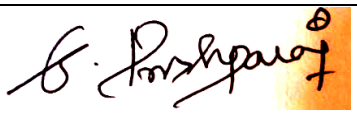
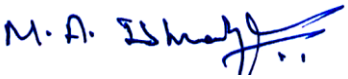
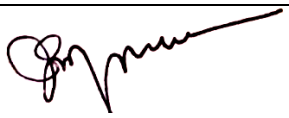
Item:6 The uniqueness of the Curriculum such as Employability Enhancement Course, Foreign language /IELTS as a Skill Development Courses, NPTEL/MOOC Courses, Mandatory courses etc, were **discussed and appreciated by the BoS members**

Item:7 Innovative Teaching / Practices Methodology adopted to handle the emerging / Advanced Technological concept courses was **discussed and appreciated the great learning platform**

The meeting was concluded at 3:40PM with vote of thanks by Dr. G. Balamuruga Mohan Raj, Chairman, Board of Studies, Department of Mechatronics Engineering, Sri Manakula Vinayagar Engineering College.

Board Chairman
Dr. G. Balamuruga Mohan Raj
Professor and Head
Department of Mechatronics Engineering,

Sl.No	Name of the Member with Designation and official Address	Responsibility in the BoS	Signature
1	**Dr. G. Balamuruga Mohan Raj** Professor and Head Department of Mechatronics Engineering, SMVEC	Chairman	
External Members			
2	**Dr.Shankar Krishnapillai,** Professor, Indian Institute of Technology, Chennai – 600 036.	Pondicherry University Nominee	
3	**Dr.D.Dinakaran,** Professor, Hindustan Institute of Tech. & Science, Chennai – 103	Subject Expert	
4	**Dr.R.Parameshwaran,** Professor, Kongu Engineering College, Erode – 638 606	Subject Expert	
5	**Mr.P.Ramesh** Managing Director, Switching Technologies Gunther Ltd., Tambaran, Chennai – 600045	Industry Expert	
Internal Members			
6	**Dr. A.G.Ganesh Kumar, M.E., Ph.D** Professor	Member	
7	**Prof. P. Ramesh Kumar, M.E,** Assistant Professor	Member	

8	**Dr. R. Kurinjimalar, M.E., Ph.D.,** Associate Professor	Member	
9	**Prof. Pushaparaj, M.E.** Assistant Professor	Member	
Co-opted Members			
10	**Prof. N. Vijayan** Assistant Professor / Mathematics	Member	
11	**Dr. A. Rajappa** Associate Professor / Chemistry	Member	
12	**Dr. M. A. Ishrath Jahan** Associate Professor / English	Member	
13	**Dr. T. Sivaranjani** Associate Professor / Physics	Member	

Annexure – I

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MCT61	Embedded System Design	PC	2	2	0	3	25	75	100
2	U19MCT62	Fluid Power Systems	PC	3	0	0	3	25	75	100
3	U19MCT63	Industrial Robotics	PC	2	2	0	3	25	75	100
4	U19MCT64	Design of Mechanical Elements	PC	2	2	0	3	25	75	100
5	U19MCE6X	Professional Elective - III[#]	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective – III[$]	HS	3	0	0	3	25	75	100
Practical										
7	U19MCP61	Embedded System Design Lab	PC	0	0	2	1	50	50	100
8	U19MCP62	Fluid Power Systems Lab	PC	0	0	2	1	50	50	100
9	U19MCP63	Industrial Robotics Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MCC6X	Certification Course – IV**	EEC	0	0	4	-	100	-	100
11	U19MCS61	Skill Development Course 7: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U19MCS62	Skill Development Course 8: Technical Seminar	EEC	2	0	0	-	100	-	100
13	U19MCS63	Skill Development Course 9: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U19MCM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19MCE51	MEMS and Nano Technology
2	U19MCE52	IoT for Mechatronics
3	U19MCE53	Operations Research
4	U19MCE54	Biomedical Instrumentation
5	U19MCE55	Data Base Management System

U20MCT203 MANUFACTURING TECHNOLOGY

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives:

- To impart knowledge on casting technology and foundry shop
- To familiarize with various metal joining processes
- To discuss the mechanical deformation processes
- To impart knowledge on various non-metallic processes
- To learn about the various methods for processing plastic materials.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 Identify the suitable casting process as required.(**K3**)
CO2 Select the required metal joining process.(**K3**)
CO3 Understand the differences among various metal deformation processes. (**K3**)
CO4 Choose the suitable metal removal process as per the requirement.**(K3)**
CO5 Identify the best method for processing plastics.(**K3**)

UNIT I CASTING PROCESSES (9 Hrs)

Introduction to Moulding and Casting, Moulding sand: Types, properties, preparation of dry and 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 JOINING PROCESSES (9 Hrs)

Fusion welding processes - Types of Gas Welding, Oxy-Acetylene Welding Equipment - Flame characteristics - Electric-Arc Welding, Electrodes, manual metal arc welding, Carbon Arc Welding, Inert-Gas Shielded Arc Welding, Tungsten Inert-Gas Welding (TIG), Gas Metal-Arc Welding (GMAW), Submerged Arc-Welding (SAW), Resistance Welding and its types and applications-Welding Defects. Soldering and Brazing- welding of non-metals.

Unit III METAL FORMING PROCESSES (9 Hrs)

Cold and Hot working: Rolling – Forging – Extrusion – Drawing – Sheet metal forming processes – High Energy Rate Forming Processes: Explosive Forming – Electro Hydraulic Forming – Electro Magnetic Forming.

Unit IV METAL MECHINING PROCESSES (9 Hrs)

Mechanics of machinery–Chip formation-types of chips, orthogonal & oblique cutting–Tool wear–Tool life – Nomenclature of single point cutting tool & Twist drill bit – Effect of cutting fluids.

Unit V PROCESSING OF PLASTICS AND COMPOSITE MATERIALS (9 Hrs)

Types of Plastics – Types of Molding: Injection molding – Blow molding – Compression molding – Transfer molding – Thermoforming – Reinforced plastics – Metal Matrix Composites – Ceramic Matrix Composites.

Text Books:

1. Rao P N, 'Manufacturing Technology', Volume I & II, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition, 2018.
2. Sharma P C, 'A Text Book of Manufacturing – I', S Chand & Company Pvt Ltd, 2008.
3. Rajput R K, 'A Text Book of Manufacturing Technology', Laxmi Publications, New Delhi, 2nd edition, 2017.

Reference Books:

1. Kaushish J P, 'Manufacturing Processes', Second Edition, PHI Learning Pvt. Ltd, 2013.
2. Kalpakjian S, Schmid R, 'Manufacturing Engineering and Technology', Seventh Edition, Pearson Education India Edition, 2013.
3. Adithan M, Gupta A B, 'Manufacturing Technology', New Age, Fifth Edition, 2012.
4. B S Nagendra Parashar, R K Mittal, 'Elements of Manufacturing Processes', Prentice Hall India Pvt. Ltd, 2003.
5. S K Hajra Choudry, 'Workshop Technology', Vol – I & II, Media Promoters and Publishers Pvt. Ltd, 2009.

Web References:

1. https://nptel.ac.in/courses/112/107/112107219
2. https://nptel.ac.in/courses/112/105/112105127/
3. https://www.coursera.org/courses?query=manufacturing
4. https://www.udemy.com/topic/manufacturing/
5. https://www.linkedin.com/company/manufacturing-technology-inc

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3
2	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3
3	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3
4	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3
5	3	3	3	2	3	-	1	-	-	-	-	3	3	3	3

EMPLOYABILITY ENHANCEMENT COURSES – (B). SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U19MCS31	Skill Development Course 1 : General Proficiency - I
2	U19MCS32	Skill Development Course 2 *
		1) Excel for Statistical Approach
		2) Training on Arduino
		3) Computer Vision
3	U19MCS41	Skill Development Course 3 : General Proficiency - II
4	U19MCS42	Skill Development Course 4 *
		1) Power Transmission Systems
		2) 3D Printing
		3) Non-Destructive Testing
5	U19MCS51	Skill Development Course 5 : Foreign Language/ IELTS -I
6	U19MCS52	Skill Development Course 6 : Presentation Skills using ICT
7	U19MCS61	Skill Development Course 7 : Foreign Language/ IELTS - II
8	U19MCS62	Skill Development Course 8 : Technical Seminar
9	U19MCS63	Skill Development Course 9 : NPTEL/MOOC - I
10	U19MCS81	Skill Development Course 10 : NPTEL/MOOC-II

**** Any one course to be selected from the list***

Annexure- II

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MCT61	Embedded System Design	PC	2	2	0	3	25	75	100
2	U19MCT62	Fluid Power Systems	PC	3	0	0	3	25	75	100
3	U19MCT63	Industrial Robotics	PC	2	2	0	3	25	75	100
4	U19MCT64	Design of Mechanical Elements	PC	2	2	0	3	25	75	100
5	U19MCE6X	Professional Elective - III[#]	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective – III[$]	HS	3	0	0	3	25	75	100
Practical										
7	U19MCP61	Embedded System Design Lab	PC	0	0	2	1	50	50	100
8	U19MCP62	Fluid Power Systems Lab	PC	0	0	2	1	50	50	100
9	U19MCP63	Industrial Robotics Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MCC6X	Certification Course – IV**	EEC	0	0	4	-	100	-	100
11	U19MCS61	Skill Development Course 7: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U19MCS62	Skill Development Course 8: Technical Seminar	EEC	2	0	0	-	100	-	100
13	U19MCS63	Skill Development Course 9: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U19MCM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U19MCE61	Introduction to Finite Element Analysis
2	U19MCE62	Automotive Electronics
3	U19MCE63	VLSI Design
4	U19MCE64	Virtual Instrumentation
5	U19MCE65	Intelligent Control System

Annexure – III

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MCT51	Microprocessors and Controllers	PC	3	0	0	3	25	75	100
2	U19MCT52	Control Systems for Mechatronics Systems	PC	2	2	0	3	25	75	100
3	U19MCT53	CNC and Metrology	PC	3	0	0	3	25	75	100
4	U19MCT54	Thermal Engineering and Heat Transfer	PC	2	2	0	3	25	75	100
5	U19MCE5X	Professional Elective - II[#]	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective – II[$]	OE	3	0	0	3	25	75	100
Practical										
7	U19MCP51	Microprocessor and Controllers Lab	PC	0	0	2	1	50	50	100
8	U19MCP52	CNC and Metrology Lab	PC	0	0	2	1	50	50	100
9	U19MCP53	Thermal Engineering Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MCC5X	Certification Course – III**	EEC	0	0	4	-	100	-	100
11	U19MCS51	Skill Development Course 5: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
12	U19MCS52	Skill Development Course 6: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19MCM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	700	600	1300

Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19MCE51	MEMS and Nano Technology
2	U19MCE52	IoT for Mechatronics
3	U19MCE53	Operations Research
4	U19MCE54	Biomedical Instrumentation
5	U19MCE55	Data Base Management System

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MCT61	Embedded System Design	PC	2	2	0	3	25	75	100
2	U19MCT62	Fluid Power Systems	PC	3	0	0	3	25	75	100
3	U19MCT63	Industrial Robotics	PC	2	2	0	3	25	75	100
4	U19MCT64	Design of Mechanical Elements	PC	2	2	0	3	25	75	100
5	U19MCE6X	Professional Elective - III[#]	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective – III[$]	HS	3	0	0	3	25	75	100
Practical										
7	U19MCP61	Embedded System Design Lab	PC	0	0	2	1	50	50	100
8	U19MCP62	Fluid Power Systems Lab	PC	0	0	2	1	50	50	100
9	U19MCP63	Industrial Robotics Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										

10	U19MCC6X	Certification Course – IV**	EEC	0	0	4	-	100	-	100
11	U19MCS61	Skill Development Course 7: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U19MCS62	Skill Development Course 8: Technical Seminar	EEC	2	0	0	-	100	-	100
13	U19MCS63	Skill Development Course 9: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U19MCM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U19MCE61	Introduction to Finite Element Analysis
2	U19MCE62	Automotive Electronics
3	U19MCE63	VLSI Design
4	U19MCE64	Virtual Instrumentation
5	U19MCE65	Intelligent Control System

SEMESTER – V										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20BST551	Operations Research	BS	2	2	0	3	25	75	100
2	U20MCT510	Control Systems for Mechatronics Systems	PC	2	2	0	3	25	75	100
3	U20MCT511	Microprocessors and Controllers	PC	3	0	0	3	25	75	100
4	U20MCT512	CNC and Metrology	PC	3	0	0	3	25	75	100
5	U20MCE5XX	Professional Elective -II	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective -II	OE	3	0	0	3	25	75	100
Practical										
7	U20MCP507	Microprocessors and Controllers Lab	PC	0	0	2	1	50	50	100
8	U20MCP508	Virtual Instrumentation Lab	PC	0	0	2	1	50	50	100
9	U20MCP509	CNC and Metrology Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MCC5XX	Certification Course – V**	EEC	0	0	4	-	100	-	100
11	U20MCS504	Skill Development Course 4: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
12	U20MCS505	Skill Development Course 5: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20MCM505	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20MCE506	MEMS and Nano Technology
2	U20MCE507	Smart materials for Mechatronics
3	U20MCE508	IoT for Mechatronics
4	U20MCE509	Biomedical Instrumentation
5	U20MCE510	Data Base Management System

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20MCT613	Embedded System Design	PC	2	2	0	3	25	75	100
2	U20MCT614	Fluid Power Systems	PC	2	2	0	3	25	75	100
3	U20MCT615	Industrial Robotics	PC	3	0	0	3	25	75	100
4	U20MCT616	Design of Mechanical Elements	PC	3	0	0	3	25	75	100
5	U20MCE6XX	Professional Elective – III	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective III	HS	3	0	0	3	25	75	100
Practical										
7	U20MCP610	Embedded System Design Lab	PC	0	0	2	1	50	50	100
8	U20MCP611	Fluid Power Systems Lab	PC	0	0	2	1	50	50	100
9	U20MCP612	Industrial Robotics Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MCC6XX	Certification Course – IV**	EEC	0	0	4	-	100	-	100
11	U20MCS606	Skill Development Course 6: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U20MCS607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20MCS608	Skill Development Course 8: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20MCM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	800	600	1400

Professional Elective – III (Offered in Semester VI)		
Sl. No.	Course Code	Course Title
1	U20MCE611	Introduction to Finite Element Analysis
2	U20MCE612	Automotive Electronics
3	U20MCE613	VLSI Design
4	U20MCE614	Virtual Instrumentation
5	U20MCE615	Intelligent Control System

U19MCT51 U20MCT511	MICROPROCESSOR AND CONTROLLERS	L 3	T 0	P 0	C 3	Hrs 45

Course Objectives

- To achieve knowledge about 8085 and 8051 microcontrollers
- To know about C programming using 8051 microcontroller
- To expand knowledge of internal and external peripherals
- To apply microcontroller for mechatronics applications
- To pioneer the architecture of advanced microprocessors and microcontrollers.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basic concepts of 8085 microprocessor and 8051 microcontroller (K2)
CO2 - Interpret the Embedded C programming concepts with 8051 microcontroller (K2)
CO3 - Develop programming using internal and external peripherals with microcontroller (K3)
CO4 - Function of a microcontroller based system for Mechatronics applications (k5)
CO5 - Design the architecture of ARM processor and PIC microcontroller.(K6)

Unit I 8085 Microprocessor **9 Hrs**

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

Unit II 8051 Microcontrollers **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 McKinlayRolin, “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. SubrataGhoshal, “Embedded Systems &Robots : Projects Using the 8051 Microcontroller”, 2009.
4. Lyla B. Das,” The X86 Microprocessor”, Pearson India, 2014
5. Dan Harres “MSP430-based Robot Applications: A Guide to Developing Embedded Systems” Newnes; 1 edition 2013

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1. https://swayam.gov.in/nd1_noc20_ee42/preview
2. https://nptel.ac.in/courses/108/105/108105102/

3. https://www.youtube.com/watch?v=liRPtvj7bFU

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCT52 U20MCT510	CONTROL SYSTEM FOR MECHATRONICS	L 3	T 1	P 0	C 4	Hrs 60

Course Objectives

- To introduce the elements of control system and their modelling using various techniques.
- To revise the procedures for analysing the time response in a system.
- To find out the frequency response and analysing the system.
- To be familiar with the stability of systems.
- To establish the state variable analysis method.

Course Outcomes

After completion of the course, the students are able to

CO1 - Demonstrate the various control system elements and their representations.(K2)

CO2 – Develop the various time domain parameters. (K3)

CO3 - Analyze the various frequency response plots and its system. (K4)

CO4 - Estimate the concepts of various system stability criterions.(K5)

CO5 - Design various transfer function of digital control system using variable models. (K6)

UNIT I CONTROL SYSTEM MODELING (9 Hrs)

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function, Modelling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques - Signal flow graph.

UNIT II TIME RESPONSE ANALYSIS (9 Hrs)

Time response analysis - First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors – P, PI, PD and PID Compensation.

UNIT III FREQUENCY RESPONSE ANALYSIS (9 Hrs)

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol's Chart - Use of Nichol's Chart in Control System Analysis. Series, Parallel, series-parallel Compensators - Lead, Lag, Lead Lag Compensators.

UNIT IV STABILITY ANALYSIS (9 Hrs)

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability.

UNIT V STATE VARIABLE ANALYSIS (9 Hrs)

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability – State space representation for Discrete time systems.

Text Books

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.

Reference Books

1. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition, 1995.
2. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 2nd Edition, 2002.
3. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill, 2007.
4. John J.D'Azzo& Constantine H.Houpis, "Linear Control System Analysis and Design'", Tata McGraw-Hill, Inc., 1995.
5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

Web References

1. https://en.wikibooks.org/wiki/Control_Systems/Resources

2. https://www.tutorialspoint.com/control_systems/control_systems_useful_resources.htm
3. https://mechatronics.colostate.edu/resources/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCT53 U20MCT512	CNC AND METROLOGY	L 3	T 1	P 0	C 4	Hrs 60

Course Objectives

- To be familiar with about basic concepts of metal cutting and CNC machines
- To recognize about various tooling systems and fixtures
- To expand knowledge in economics
- To grow up knowledge in angular measurement systems
- To determination of the process capabilities and ensure that these are better than the relevant component tolerances.

Course Outcomes

CO1 - Explain the parameters of metal cutting and comprehend the basic components, drives and controls involved in a CNC system (K2)

CO2 - Select various tooling systems and fixtures for CNC and identify maintenance features of CNC machines (K3)

CO3 - Apply the concepts of economics in CNC machine handling (K3)

CO4 - Infer linear and angular measurements using various instruments (K2)

CO5 - Conclude methods of measurement for various physical quantities.(K5)

Unit I Basic Concepts Of Metal Cutting and CNC Machines **12 Hrs**

CNC machines: 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 Hrs**

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.

Unit III Economics of CNC Machines **12 Hrs**

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 IV Linear and Angular Measurements **12 Hrs**

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.

Unit V Interferometry and Laser Metrology **12 Hrs**

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. Narang J.S. and Narang V.D.S., “CNC Machines and Automation”, Dhanpat Rai and Co. Pvt. Ltd., 2016.
2. HMT Limited, “Mechatronics”, Tata McGraw-Hill, New Delhi, 2001
3. Jain R.K., ―Engineering Metrology‖, Khanna Publishers, New Delhi, 2013

References

1. M. Adithan, B.S. Pable, “CNC Machines”, New age international publications,2016
2. Mahesh Dhotre, D. Rao, “CNC Machine Tool Technology with Programming and Operating”, Saitech publications 2016
3. Mahajan M, “Textbook Of Metrology”, Dhanpat rai & Co.2010.
4. Raghavendra,, Krishnamurthy,” Engineering Metrology and Measurements” OUP India, 2013
5. Anil Akdogan” Metrology “ BoD – Books on Demand – 2018

6. E. Mainsah, J.A. Greenwood, D.G. Chetwynd Metrology and Properties of Engineering Surfaces" Springer Science & Business Media – 2013.

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1. https://nptel.ac.in/courses/112/105/112105211/
2. https://nptel.ac.in/courses/112/106/112106179/
3. https://swayam.gov.in/nd1_noc19_me46/preview
4. https://swayam.gov.in/nd1_noc20_me94/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCT54	THERMAL ENGINEERING AND HEAT TRANSFER	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives:

- To discuss first law of thermodynamics with respect to closed and open systems
- To impart the knowledge on second law of thermodynamics and entropy
- To recognize various modes of heat transfer in steady and transient condition.
- To discuss convective heat transfer in various systems.
- To describe radiation heat transfer for various geometries.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 Understand the basic concepts associated with the first law of thermodynamics.(K2)
CO2 Understand the basic concepts associated with the second law of thermodynamics.(K2)
CO3 Analyze steady state and transient heat conduction problems of real life Thermal systems.(K4)
CO4 Understand the convective heat transfer problems in various thermal systems.(K2)
CO5 Analyze radiation heat transfer problems in various thermal systems.(K4)

UNIT I IC ENGINES (12 Hrs)

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 Hrs)

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 - CONDUCTION (12 Hrs)

Introduction of heat transfer – conduction - convection and radiation – Laws – General equation of heat conduction – Derivation in Cartesian - cylindrical and spherical coordinates – One dimensional steady state heat conduction in simple geometries – plane wall - cylinder and sphere –Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts

UNIT IV - CONVECTION (12 Hrs)

Boundary layer theory – Hydrodynamic and Thermal Boundary Layer- Dimensional Analysis-Flow over a flat– Flow over cylinders -spheres - tube bank.

UNIT V - RADIATION (12 Hrs)

Radiation heat transfer –Thermal radiation – Laws of radiation – Black body concept – Greay body radiation - Emissive power – Radiation shape factor-radiation heat exchange between surfaces – Electrical Analogy – Radiation Shields-Radiation through gases.

Text book:

1. Nag P. K., Engineering Thermodynamics, McGraw Hill Education India Pvt. Ltd, 2017.
2. Sachdeva R. C., Fundamentals of Heat and Mass Transfer, New AgeInternationalPublishers, 2017.
3. Rajput R K "A text book of Engineering Thermodynamics", S. Chand publishers, 2016

Reference books:

1. Moran and Shapairo, Principles of Engineering Thermodynamics, 8th Edition, Wiley, 2015
2. Yunus A. Cengel, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education, 2016.
3. Frank P. Incropera and David P. Dewitt, Incropera's principles of Heat and Mass Transfer, Wiley India Edition, 2018.
4. C. P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers, 2018.

5. Arora C.P, "Thermodynamics", 25th Reprint, McGraw-Hill, New Delhi, 2013.

Web References

1. https://nptel.ac.in/courses/112105266/
2. https://nptel.ac.in/courses/112108148/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://www.linkedin.com/company/heat-transfer-and-process-design-htpd
5. https://www.udemy.com/course/an-introduction-to-heat-transfer/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U20BST551 **OPERATIONS RESEARCH**

L	T	P	C	Hrs
2	2	0	4	60

Course Objectives

- To understand the role of operation research in decision making.
- To provide knowledge and training in using optimization techniques.
- To impart the various operation research models for effective problem solving.
- To know the basics and the methods of solving inventory theory and problems.
- To acquire knowledge in principles of Queuing theory.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the characteristics of different types of decision making environments.
CO2 - Solve Transportation Models and Assignment Models.
CO3- Design new simple models by using critical path method.
CO4- Understand the applications of inventory and replacement concepts
CO5- Apply Queuing theory and solve problems related to it.

UNIT I LINEAR PROGRAMMING (12 Hrs)

Stages of Development of Operations Research – Applications of Operations Research – Limitations of Operations – Introduction to Linear Programming – Graphical Method – Simplex Method – Duality.

UNIT II TRANSPORTATION PROBLEMS (12 Hrs)

Basic feasible solution by different methods – Fixing optimal solutions – Stepping stone method – MODI method – Assignment problem – Formulation – Optimal solution.

UNIT III NETWORKS MODELS (12 Hrs)

Shortest Path Problem – Floyd's Algorithm – Minimum Spanning Tree Problem – CPM/PERT – Crashing of a Project network.

UNIT IV INVENTORY ANALYSIS AND REPLACEMENT MODELS (12 Hrs)

Inventory cost – Classification of Fixed first order Quantity Inventory Models- Inventory models with Deterministic Demand- Inventory models with probabilistic Demand. Replacement Models –types of failures- Replacement of items that deteriorate.

UNIT V QUEUING THEORY (12 Hrs)

Basic Waiting Line Models: (M/M/1):(GD/α/α) – (M/M/1):(GD/N/α) – (M/M/C):(GD/α/α) – M/M/C):(GD/N/α).

Text Books

1. Michael W.Carter, Camille C.Price, GhaithRabadi, "Operation Research – A Practical Introduction", Chapman and Hall/CRC, 2nd Edition 2018.
2. Jiongmin Yong, "Optimization Theory: A Concise Introduction", World scientific publishing company, 2018.
3. John F. Shortle, James M. Thompson, Donald Gross, Carl M. Harris, "Fundamentals of Queuing Theory", 5th Edition,2018.

Reference Books

1. A.RaviRavindran, "Operations Research Methodologies", Taylor and Francis, 2019.
2. Hastings, Kevin J. "Introduction to the Mathematics of Operations Research with Mathematics", Taylor and Francis, 2019.
3. Er.Prem Kumar Gupta, Dr.D.S.Hira," Operations Research" S. chant& Company Pvt. Ltd, **7th** Edition,2014.
4. J. K. Sharma. "Operations Research Theory and Applications", Macmillan India Ltd, 5th Edition, 2013.

Web Resources

1. https://www.researchgate.net/publication/313880623
2. https://nptel.ac.in/courses/117/103/117103017
3. https://nptel.ac.in/courses/111/107/111107128/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	-	-	-	-	-	1	3	2	2
2	3	2	1	1	-	1	-	-	-	-	-	1	3	2	2
3	3	2	1	1	-	1	-	-	-	-	2	1	3	2	2
4	2	1	-	-	-	1	-	-	-	-	2	1	3	2	2
5	3	2	1	1	-	1	-	-	-	-	2	1	3	2	2

U19MCP51 U20MCP507	MICROPROCESSORS AND CONTROLLERS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To know about programming for 8085 microprocessor and 8051 microcontrollers
- To enlarge a microcontroller based system for Mechatronics applications
- To Verify programming logic and interfacing circuits using simulation software
- To develop the quality of assessing and analyzing the obtained data.
- To expose students to the operation of typical microprocessor (8085) trainer kit.

Course Outcomes

CO1 - Relate programming for 8085 microprocessor and 8051 microcontroller (K2)
CO2 - Utilize programming logic and interfacing circuits using simulation software (K3)
CO3 - Develop a microcontroller based system for Mechatronics applications (K3)
CO4 - Compare testing and experimental procedures on Microprocessor and Microcontroller analyze their operation under different cases. (K5)
CO5 - Prove professional quality textual and computational results, incorporating accepted data analysis and synthesis methods, simulation software, and word-processing tools.(K5)

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

References

1. G.T. Swamy “Microprocessor (8085) Lab Manual” Firewall Media. – 2006
2. KalpathiRamani “Microcontrollers And Applications With Lab Manual” Pearson Education India – 2010
3. NAVAS, K. A. “ELECTRONICS LAB MANUAL (VOLUME 2)” PHI Learning Pvt. Ltd. 2018
4. D.A.GodseA.P.Godse” Microprocessors and microcontroller” Technical Publications. – 2008
5. Dr Anita Gehlot, Dr Rajesh Singh, P. Raja “Microprocessor and Microcontroller Interview Questions: A complete question”BPB Publication – 2020

Web References

1. https://www.iitk.ac.in/new/microprocessor-and-microcontroller-laboratory

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
2	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
3	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
4	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
5	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCP52 U20MCP509	CNC AND METROLOGY LABORATORY	L 0	T 0	P 2	C 1	Hrs 30

Course Objectives

- To practice and execute the part program using CNC trainer machines
- To interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments
- To measurements with and calibration of instruments
- To simulate using CAM package and interface the developed program with the machines
- To develop, simulate and execute part program using CNC production machines

Course Outcomes

CO1 - Relate and execute the part program using CNC trainer machines (K2)
CO2 - Develop, simulate and execute part program using CNC production machines(K3)
CO3 - Discover using CAM package and interface the developed program with the machines(K4)
CO4 - Interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments(K5)
CO5 - The select and use the appropriate measuring instrument according to a specific requirement (K5)

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

References

1. Peter Smid “CNC Control Setup for Milling and Turning: Mastering CNC Control Systems“Industrial Press Inc - 2010
2. Dennis A. Keeling “How to Use a Cnc Router: A Practical Guide for Beginners “Create Space Independent Publishing Platform, 2017
3. James A. Harvey” CNC Trade Secrets: A Guide to CNC Machine Shop Practices” Industrial Press, Incorporated, 2014
4. BEWOOR “METROLOGY & MEASUREMENT” Tata McGraw-Hill Education 2009
5. Zhiyong Ma, David G. Seiler “Metrology and Diagnostic Techniques for Nanoelectronics CRC Press. “– 2017.
6. Jerzy A. Sładek “Coordinate Metrology: Accuracy of Systems and Measurements **“**Springer**.- 2015**

Web References

1. https://www.youtube.com/watch?v=pPwyYFvRLts
2. https://www.youtube.com/watch?v=HpIEeBtJupY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
2	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
3	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
4	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
5	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCP53	THERMAL ENGINEERING LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives:

- To discuss various properties of liquid fuels.
- To relate convection heat transfer concepts to do experimentation on the heat transfer systems.
- To apply conduction heat transfer concepts to do an analysis on heat transfer equipment.
- To understand the functioning and performance of Air compressor and Blower.
- To describe the principle of parallel flow and counter flow heat exchangers.

Course Outcomes

On successful completion of this course, the student will be able to

CO1 Understand about various fuels and their properties.(K2)
CO2 Demonstrate the fundamental principles of convective heat transfer in practice (**K3**)
CO3 Demonstrate the fundamental principles of conductive heat transfer in real life systems practice (**K3**)
CO4 Analyse and assess the performance of Air compressor and Blower (**K4**)
CO5 Model and test heat exchanging system.(**K5**)

List of Experiments

1. Determination of Kinematic Viscosity using Redwood viscometer
2. Determination of Flash and fire point using Cleveland apparatus
3. Determination of Heat transfer coefficient for heat transfer from cylindrical surface by natural convection
4. Determination of Heat transfer coefficient for heat transfer from cylindrical surface by forced convection
5. Determination of Heat transfer coefficient for heat transfer from Pin fin by natural convection
6. Determination of Heat transfer coefficient for heat transfer from Pin fin by forced convection
7. Determination of thermal resistance and conductivity of a composite wall
8. Determination of emissivity of a specimen
9. Performance test on reciprocating air compressor
10. Performance test on air blower
11. Performance analysis of Parallel and Counter flow heat exchanger
12. Heat transfer studies using a plate type heat exchanger

Reference Books

1. Sachdeva R. C. Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd, (2017),
2. Holman J. P.Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited, 2011),
3. Kothandaraman C. P. and Subramanyan.S, Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers (2018),
4. R.K.Rajput, Thermal Engineering, 10th edition, Lakshmi Publications, 2018.
5. Yunus A. Cengel, Robert H. Turner, John M. Cimbala, Fundamentals of Thermal-Fluid Sciences, Indian edition, 2016

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	-	-	-	3	-	-	3	1	2	2
2	3	3	3	3	3	-	-	-	3	-	-	3	1	2	2
3	3	3	3	3	3	-	-	-	3	-	-	3	1	2	2
4	3	2	2	3	3	-	-	-	3	-	-	3	1	2	2
5	3	2	2	3	3	-	-	-	3	-	-	3	1	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20MCP508	VIRTUAL INSTRUMENTATION LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives:

- To acquire knowledge about Lab VIEW Programming.
- To interfacing of different sensors with Lab VIEW.
- To understand the principles of Virtual Instrumentation (VI) and learn the basics for creating Virtual Instrument.
- To learn creating sub VIs from section of a VI.
- To become skilled at GSD for real time monitoring using Seven-Segment LED Display

Course Outcomes:

CO1 - Interpret the software tools in virtual instrumentation (K2)
CO2 - Develop programming through Lab VIEW graphical programming environment (K3)
CO3 - Perform interface of data acquisition hardware with Lab VIEW software (K4)
CO4 - Select the hardware and software concept of data acquisition system for advanced applications(K5)
CO5 - Choose and apply for various GSD string function.(K5)

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

References

1. Johnson, G., LabVIEW Graphical Programming, McGraw Hill (2011).
2. Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).
3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (2006).
4. Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America (1994).
5. Jovitha Jerome, Virtual Instrumentation Using Lab view PHI Learning Pvt. Ltd., (2010)

Web References

1. https://www.pec.ac.in/ece/virtual-instrumentation-lab.
2. https://www.iitr.ac.in/departments/EE/pages/Research+Facilities+Labs+Virtual_Instrumentation _Laboratory. html
3. https://www.vlab.co.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
2	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
3	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
4	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3
5	3	2	2	1	3	-	-	-	3	-	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCT61 U20MCT613	EMBEDDED SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the Embedded concepts and Embedded System Architecture
- To learn the architecture and programming of ARM Cortex Microcontroller
- To select a proper Microcontroller for an application
- To understand the usage of the development and debugging tools
- To learn and apply the knowledge of Memory systems and Peripherals

Outcomes

Upon completion of the course, students will be able to

CO1- Infer the fundamentals of an embedded system and compare with general purpose System (K2)
CO2- Illustrate the methods adapted for the development of a typical Embedded system (K3)
CO3- Demonstrate the RTOS and related mechanisms like an ability to design a system, component, or process to meet desired needs within realistic constraints (K3)
CO4- Identify, formulate, and solve engineering problems (K4)
CO5- Use the techniques, skills, and modern engineering tools necessary for engineering practice (K4)

UNIT I INTRODUCTION TO EMBEDDED SYSTEM (9Hrs)

Embedded system processor, hardware unit, software embedded into a system, Example of an embedded system, Embedded Design life cycle, Embedded System modelling [flow graphs, FSM, Petri nets], Layers of Embedded Systems.

UNIT II PROCESSOR AND MEMORY ORGANIZATION (9Hrs)

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-processors and Hardware Accelerators, pipelining.

UNIT III I/O DEVICES AND NETWORKS (9Hrs)

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 (9Hrs)

Basic Features of an Operating System, Kernel Features [polled loop system, interrupt driven 113 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 (9Hrs)

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-toleranceTechniques, Reliability Evaluation Techniques.

Text Books

1. Rajkamal, Embedded System-Architecture, Programming, Design, Mc Graw Hill, 2013.
2. Peckol, Embedded system Design, John Wiley and Sons,2010
3. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson, 2013

Reference Books

1. Shibu. K.V, Introduction to Embedded Systems, Tata Mcgraw Hill,2009.
2. Elicia White, Making Embedded Systems, O Reilly Series, SPD,2011.
3. Tammy Noergaard Embedded Systems Architecture, Elsevier, 2006.
4. Han-Way Huang, Embedded system Design Using C8051, Cengage Learning,2009.
5. Rajib Mall Real-Time systems Theory and Practice Pearson Education, 2007.

Web Resources

1. https://www.inspirenignite.com/anna-university/introduction-to-embedded-systems-mechatronics-7th-sem-syllabus-for-be-2017-regulation-anna-univ-open-elective-ii/
2. https://www.edn.com/mechatronics-based-embedded-design/
3. https://www.intechopen.com/books/design-control-and-applications-of-mechatronic-systems-in-engineering/embedded-controller-design-for-mechatronics-system
4. https://www.embeddedcomputing.com/application/misc/mechatronics-aids-in-embedded-system-design
5. https://www.hindawi.com/journals/jr/2012/932305/

COs / POs / PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	1	1	2
2	3	3	3	2	2	-	-	-	-	-	-	2	1	1	2
3	2	2	2	-	1	-	-	-	-	-	-	2	1	1	2
4	2	3	3	2	2	-	-	-	-	-	-	2	1	1	2
5	3	3	3	-	2	-	-	-	-	-	-	2	1	1	2

Correlation Level: 1-Low, 2-Medium, 3-High

U19MCT62	FLUID POWER SYSTEM	L	T	P	C	Hrs
U20MCT614		2	2	0	3	60

Course Objectives

- To understand the concepts, construction and working principles of fluid power system
- To recognize the construction and working of pumps and actuators for hydraulic system
- To identify the usage of various directional control valves in hydraulic systems
- To be aware of the performance of pneumatic systems
- To apply various methods to design and execute hydraulic and pneumatic systems.

Course Outcomes

CO1 - Illustrate the fundamentals of hydraulic systems and determine losses incurred in hydraulic circuit (K2)
CO2 - Experiment with the suitable pump and actuators for particular application.(K3)
CO3 - Make use of various hydraulic valves.(K3)
CO4 - Analyze various fundamentals of pneumatic systems. (K5)
CO5 - Develop hydraulic and pneumatic circuits for simple application (K6)

UNIT I FLUID POWER SYSTEMS **12 Hrs**

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 Hrs**

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 Hrs**

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 Hrs**

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 Hrs**

Sequential circuit design for simple applications: Step counter method, Cascade methods &KarnaughVeitch 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

1. Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2015.
2. Patrick J. Klette "Fluid Power Systems" American Technical Publishers, Incorporated, 2014
3. MD FAIYAZ AHMED "FLUID POWER CONTROL SYSTEMS"Lulu.com. – 2016.
4. NicolaeVasiliu, Daniela Vasiliu, Constantin C?LINOIU" Simulation of Fluid Power Systems with SimcenterAmesim "CRS Press – 2018
5. Yaobao Yin "Electro Hydraulic Control Theory and Its Applications Under Extreme Environment"Butterworth-Heinemann– 2019
6. P.K. Guha "Hydraulic Pumps & Motors and their Applications" Dog Ear Publishing. 2018

Web References

1. https://nptel.ac.in/courses/112/104/112104117/

2. https://nptel.ac.in/courses/112/105/112105206/
3. https://swayam.gov.in/nd1_noc20_me55/preview
4. https://www.youtube.com/watch?v=S_4anj7GpRo

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCT63 / U20MCT615	INDUSTRIAL ROBOTICS	L	T	P	C	Hrs
		3	0	0	3	45

Course 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 provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
- To develop the student's knowledge in various robot structures and their workspace.

Course Outcomes

CO1- Understand the components and parameters of industrial robots (K2)
CO2 - Solve forward kinematics, inverse kinematics and Jacobian for serial and parallel robots (K3)
CO3 - Analyze the classification of end effectors.(K4)
CO4 - Evaluate the kinematic calculations to the industrial robots.(K5)
CO5 - Choose the trajectory planning to the robots.(K5)

UNIT I INTRODUCTION **9 Hrs**

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

UNIT II END EFFECTORS **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics:Technology, Programming and Applications", McGraw Hill Book Company, 2012
2. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2008

References

1. J.J. Craig, Introduction to Robotics: Mechanics and Control, Prentice Hall Inc. / Pearson Education, 2008
2. Tsai, L. W., Robot Analysis: The Mechanics of Serial and Parallel Manipulators, John Wiley & Sons, Inc, New York, 1999.
3. RamachandranNagarajan "Introduction to Industrial Robotics" Pearson Education India, 2016

4. TadejBajd, MatjazMihelj, JadranLenarcic, Ales Stanovnik, Marko Munih “Robotics (Intelligent Systems, Control and Automation: Science and Engineering)’Springer 2012
5. James Perlberg” Industrial Robotics” Cengage Learning, 2016.

Web References

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://swayam.gov.in/nd1_noc20_me03/preview
3. https://www.youtube.com/watch?v=xrwz9IxpMJg

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCT64 U0MCT616	DESIGN OF MECHANICAL ELEMENTS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives:

- To familiarize the various steps involved in the design process.
- To design shafts, keys and couplings
- To plan gears and analyzing the influence of stresses on it
- To propose brakes and clutches for automobiles with appropriate assumptions
- To devise bearings and springs with appropriate assumptions

Course Outcomes:

CO1 - Interpret the influence of steady and variable stresses in machine component design.(K2)
CO2 - Make use of concepts of shafts, keys and couplings with proper assumptions. (K3)
CO3 - Analyse of spur, helical, bevel, worm gear drives and multi speed gear box (K4)
CO4 - Function of clutches and braking systems (K4)
CO5 - Evaluate bearings and springs problems.(K5)

UNIT I DESIGN FUNDAMENTALS (12 Hrs)

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 Hrs)

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 GEARS (12 Hrs)

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

UNIT IV DESIGN OF BRAKES AND CLUTCHES (12 Hrs)

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 Hrs)

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

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCP61 U20MCP610	EMBEDDED SYSTEM DESIGN LAB	L 0	T 0	P 2	C 1	Hrs 30

Course Objectives

- To introduce using microcontrollers with foundational concepts of microcontroller architecture and programming.
- To establish hardware and software integration for real time systems using microcontrollers
- To commence to embedded systems design tools and hardware.
- To gain both simulation and practical implementation of microcontroller including timers and counters,
- To produce embedded systems I/O techniques and requirements, A/D conversion, serial communications

Course Outcomes

CO1 - Understand about Analog to digital converting technique, Pulse with modulation methods, various bus
CO2 - communication techniques, Real time clock and various sensor handling methods.(K2)
CO3 - Relate in different Operating systems such as Ubuntu, Rasbian OS. (K2)
CO4 - Apply programs in various platforms such as Embedded C, C++, HTML, DBMS. (K3)
CO5 - Analyze different types of analog and digital sensors. (K4)

List of Experiments

1. Voltage Measurement with display
2. Designing a voltmeter to measure voltage from0to5voltsanddisplaying the measured value using7segment 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 themessagessentbythemicrocontrolleronthePCusingVisualBasicprogram 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

References

1. KalpathiRamani “Microcontrollers And Applications With Lab Manual” Pearson Education India2010.
2. Manish K. Patel “The 8051 Microcontroller Based Embedded Systems” Tata McGraw-Hill Education. – 2014
3. Perry Xiao “Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed” John Wiley & Sons– 2018
4. Jonathan W. Valvano “Embedded Systems: Introduction to Robotics” Independently Published, 2019
5. James K. Peckol “Embedded Systems: A Contemporary Design Tool“ John Wiley & Sons.- 2019

Web References

1. https://nptel.ac.in/courses/106/105/106105159/
2. https://www.youtube.com/watch?v=9Q-3c0gQcok
3. https://www.youtube.com/watch?v=G9_pQzt1sts

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
2	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
3	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
4	3	2	3	3	2	-	-	-	3	-	-	2	2	2	3
5	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19MCP62 U20MCP611	FLUID POWER SYSTEMS LABORATORY	L 0	T 0	P 2	C 1	Hrs 30

Course Objectives

- To understand the concepts, construction and working principles of fluid power system Components
- To design and test the hydraulic and pneumatic circuits using MATLAB/LABVIEW software and simulate the circuits using Automation studio software.
- To familiarize in fluid power automation and different components of Hydraulics, pneumatics, electro hydraulic/ electro pneumatic and PLC based systems
- To Hands on experience in designing and executing of circuits for real systems.
- To build the circuit using Fluid SIM and try different loads in order to realize its effect on the system performance.

Course Outcomes

CO1- Show the actuators and valves for the design of fluid power circuits. (K2)
CO2 - Identify design and simulate the fluid power circuits using software tool. (K3)
CO3 - Analyzing the fluid power circuits using suitable actuators and valves.(K4)
CO4 - Evaluate operation and maintenance of common fluid power components. (K5)
CO5 - Choose standard schematic symbols for common fluid power components (K5)

List of Experiments

Design and testing of hydraulic circuits such as

- Pressure control
- Flow control
- Direction control
- Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro hydraulic Trainer kit.

Design and testing of pneumatic circuits such as

- Pressure control
- Flow control
- Direction control
- Circuits with logic controls
- Circuits with timers
- Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
- Modeling and analysis of basic electrical, hydraulic, and pneumatic systems using MATLAB/LABVIEW software

Simulation of basic hydraulic, pneumatic and electrical circuits using Automation studio software.

References

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3. Cameron Tropea, Alexander L. Yarin, John F. Foss “Springer Handbook of Experimental Fluid Mechanics” Springer Science & Business Media – 2007
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Web References

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
2	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
3	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
4	3	2	3	3	2	-	-	-	3	-	-	2	2	2	3
5	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

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Course Objectives

- To learn about different types of robots and its components.
- To understanding Robot kinematics – forward and reverse kinematics
- To gain the programming for the required robot motion
- To determine the robotic applications, by interfacing it with real environment.
- To provide analysis skills associated with trajectory planning and robot control.

Course Outcomes

CO1 - Show the type of robot and various motions.(K2)
CO2 - Build the robot forward and reverse kinematics. (K2)
CO3 - Select a suitable robot for a specific application. (K3)
CO4 - Analyzing programming Robots for performing various tasks.(K4)
CO5 - Evaluate simulate a robot which meets kinematic requirements. (K5)

List of Experiments

1. Study of the major components of the robot.
2. Study of the robotic simulation/ programming software.
3. Study of forward and reverse kinematics, to program the sequence of motion of a robot.
4. Programming an industrial robot for performing various applications involving Point-to-point motion of the manipulator arm.
5. Programming an industrial robot for performing various applications involving continuous path motion of the manipulator arm.
6. Interfacing an industrial robot with a belt conveyor.
7. Developing program for an industrial robot to perform pick and place operation.
8. Programming of Industrial Robot for material handling application
9. Programming of industrial robot for processing application
10. Simulation of various Robot work cells (SOFT WARE).
11. Programming an industrial robot for a sorting operation using a sensing system.

References

1. Rex Miller, Mark R. Miller “Robots and Robotics: Principles, Systems, and Industrial Applications “McGraw Hill Professional, 2017
2. Bruno Siciliano, OussamaKhatib “Springer Handbook of Robotics“Springer. – 2016
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4. Thomas R. Kurfess “Robotics and Automation Handbook” CRC Press. – 2018
5. Mark W. Spong, Seth Hutchinson, M. Vidyasagar “Robot Modeling and Control” John Wiley & Sons. 2020

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
2	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
3	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3
4	3	2	3	3	2	-	-	-	3	-	-	2	2	2	3
5	3	2	2	3	2	-	-	-	3	-	-	2	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Annexure – IV

DEPARTMENT VISION AND MISSION

Vision

To be a department with outstanding competencies in education and research in interdisciplinary field of Mechatronics Engineering for the prosperity of students and society.

Mission

M1 - Quality Integration: To uphold excellence in education by integrating the teaching learning process with hands-on trainings in updated technologies.

M2 - Research Exploration: To maintain a dynamic balance between learning and research by encompassing activities related to Research, Industrial projects and Innovation Contests.

M3 – Personality Development: To enrich the team spirit and entrepreneurship skills through training programmes on personality development for career prospects.

M4 – Social Ethics: To enhance the principle of highest ethical values by inculcating code of conduct for the betterment of the Society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Strong Knowledge

To provide comprehensive knowledge on Science, Mathematics & multiple Engineering disciplines, along-with the ability to apply the gained knowledge.

PEO2: Technical Competency

To produce graduates who can demonstrate technical competence in the field of Mechatronics Engineering and develop solutions to the complex problems.

PEO3: Task Orientation

To produce graduates who function effectively in a multi-disciplinary environment, individually and within a society towards accomplishing tasks.

PEO4: Team Work

To produce graduates who would be able to take individual responsibility and work as a part of a team towards the fulfillment of both individual and organizational goals.

PEO5: **Professional Competency**

To produce graduates with professional competence by life-long learning on advanced studies, professional skills and other professional activities related to Mechatronics Engineering society.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Understanding the Concepts

To comprehend the concepts of Mechatronics and their applications in the field of Automated Manufacturing Systems, Robotics, Automobile Technology, Aerial vehicles and other relevant areas.

PSO2: Application of Knowledge

To apply technical knowledge in modern hardware and software tools related to Mechatronics for solving real world problems.

PSO3: Solution Development

To develop the ability to analyze, comprehend and design mechatronics subsystems for a variety of engineering applications for the benefits of society