HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

HINDUSTHAN

COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Coimbatore – 641032

DEPARTMENT OF MECHATRONICS ENGINEERING

Curriculum and ODD Semesters Syllabus for the Batch

2024 – 2028 (R2022)

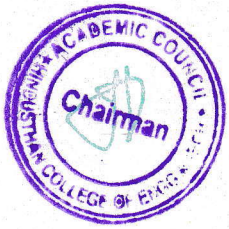
2023 – 2027 (R2022)

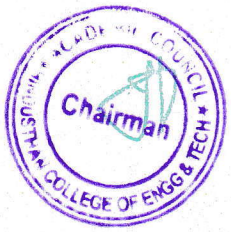
2022 – 2026 (R2022)

2021 – 2025 (R2019 with Amendments)

(Board of Studies held on 20.05.2024)

(Academic Council Meeting held on 21.06.2024)





HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

(Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' Grade)

Coimbatore - 641 032.

B.E. MECHATRONICS ENGINEERING

HINDUSTHAN
EDUCATIONAL AND CHARITABLE TRUST
HICET

CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS

Revised Curriculum and Syllabus for the Odd Semester

Academic year 2024-25

ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

2022 REGULATIONS

HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY, COIMBATORE 641 032

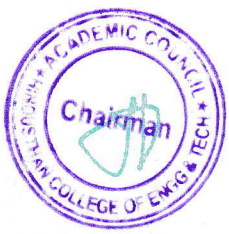
(An Autonomous Institution Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTE
To become a premier institution by producing professional with strong technical knowledge, innovative research skills and high ethical values

MISSION OF THE INSTITUTE
• To provide academic excellence in technical education through novel teaching methods. • To empower students with creative skills and leadership qualities. • To produce dedicated professionals with social responsibility

VISION OF THE DEPARTMENT
To excel in Mechatronics engineering by imparting technical knowledge, innovation skills and ethics to fulfill the global needs with human values

MISSION OF THE DEPARTMENT
• To impart sound technical knowledge and produce highly proficient professionals in the mechatronics engineering domain. • To empower students with strong competency skills to solve multi-disciplinary engineering problems using mechatronics approach. • To inculcate human values and ethical responsibility to the students for social welfare



PROGRAM EDUCATIONAL OBJECTIVE (PEOs)	
PEO 1	To produce professional graduates with the ability to synergistically integrate multi-disciplinary domains to solve complex engineering problems with Mechatronics approach.
PEO 2	To produce professional graduates with the acumen for interdisciplinary research, entrepreneurship and higher studies to meet the local and global needs.
PEO 3	To produce professional graduates with ethical and moral values in rendering services to the society.

PROGRAM OUTCOMES (POs)	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems:** Use research - based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

	PROGRAM SPECIFIC OUTCOMES (PSOs)
PSO1	To provide ability to analyze, design and develop mechatronic systems by integrating knowledge in sensors, actuators and controllers to solve complex engineering problems.
PSO2	To provide smart automation solutions for real time industrial problems using multidisciplinary approach

CURRICULUM
R2022

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. MECHATRONICS ENGINEERING (UG)

REGULATION-2022

For the students admitted during the academic year 2024-2025 and onwards

SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2	22ME1201	Engineering Drawing	ESC	1	2	0	3	5	40	60	100
THEORY WITH LAB COMPONENT											
3	22HE1151	English for Engineers	HSC	2	0	2	3	4	40	60	100
4	22PH1153	Physical Properties of Materials	BSC	2	0	2	3	4	50	50	100
5	22IT1151	Python Programming and Practices	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
7	22HE1073	Introduction to Soft Skills	SEC	1	0	0	0	1	100	0	100
MANDATORY COURSE											
8.	22MC1093/ 22MC1094	தமிழர்மரபு / Heritage of Tamils	MC	2	0	0	1	2	100	0	100
9.	22MC1095	Universal Human Values	MC	2	0	0	0	2	40	60	100
			TOTAL	**15**	**3**	**6**	**18**	**27**	**470**	**330**	**800**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA2101	Differential Equations and Complex Analysis	BSC	3	1	0	4	4	40	60	100

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

2	22PH2102	Applied Mechanics	BSC	2	0	0	2	2	40	60	100
3	22CY2101	Environmental Studies	ESC	2	0	0	2	2	40	60	100
THEORY WITH LAB COMPONENT											
4	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
5	22CY2152	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
6	22MT2251	Fundamentals of Mechatronics	PCC	2	0	2	3	4	50	50	100
PRACTICAL COURSES											
7	22ME2001	Engineering Practices	ESC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	22HE2071	Design Thinking	AEC	1	0	2	2	3	100	0	100
9	22HE2073	Soft Skills and Aptitude -I	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10.	22MC2094/ 22MC2095	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	MC	2	0	0	1	2	100	0	100
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							-
			TOTAL	**17**	**1**	**12**	**23**	**30**	**630**	**370**	**1000**

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA3105	Fourier Series and Transforms	BSC	3	1	0	4	4	40	60	100
2	22MT3201	Industrial Motor Control	ESC	3	0	0	3	3	40	60	100
3	22MT3202	Solid and Fluid Mechanics	PCC	3	1	0	4	4	40	60	100
4	22MT3203	Digitronics	PCC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
5	22MT3251R	Manufacturing Process	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
6	22MT3001	Industrial Motor Control Lab	ESC	0	0	4	2	4	60	40	100
7	22MT3002	Solid and Fluid Mechanics Lab	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											

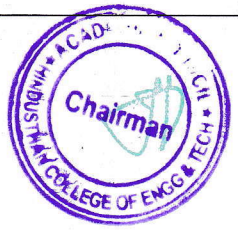
8	**22HE3071**	Soft Skills and Aptitude -II	SEC	1	0	0	1	1	100	0	100
9	**22MT3901**	Mini Project	AEC	0	0	4	2	4	60	40	100
MANDATORY COURSE											
10	**22MC3091**	Essence of Indian Traditional Knowledge	MC	1	0	0	0	1	0	100	100
			TOTAL	**16**	**3**	**14**	**25**	**33**	**490**	**510**	**1000**

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22HE4101**	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2	**22MT4201**	Processor and controller	PCC	3	0	0	3	3	40	60	100
3	**22MT4202**	Metrology and Measurements	PCC	3	0	0	3	3	40	60	100
4	**22MT4203**	Theory of Machines	PCC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
5	**22MT4251**	Sensors and Transducers	PCC	2	0	2	3	4	50	50	100
6	**22MT4252**	Fluid Power System	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
7	**22MT4001**	Processor and controller Laboratory	PCC	0	0	4	2	4	60	40	100
8	**22MT4002**	CAD Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	**22HE4071**	Soft Skills and Aptitude -III	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10	**22MC4091**	Indian Constitution	MC	1	0	0	0	1	0	100	100
			TOTAL	**17**	**1**	**12**	**23**	**30**	**480**	**520**	**1000**

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT5201**	CNC Technology	PCC	3	0	0	3	3	40	60	100
2	**22MT5202**	Control System	PCC	3	1	0	4	4	40	60	100



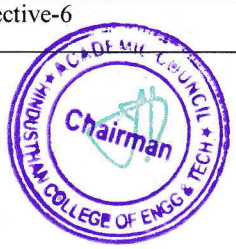
3	**22MT53XX**	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4	**22MT53XX**	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5	**22MT53XX**	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	**22MT5251**	Embedded System	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
7	**22MT5001**	CNC laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	**22HE5071**	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**18**	**0**	**6**	**21**	**25**	**410**	**390**	**800**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT6201**	Industrial Automation	PCC	3	0	0	3	3	40	60	100
2	**22HE6101**	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3	**22MT63XX**	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4	**22MT63XX**	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5	**22XX64XX**	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6	**22XX64XX**	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	**22MT6001**	Industrial Automation Laboratory	PCC	0	0	4	2	4	60	40	100
8	**22MT6002**	CAM Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	**22HE6071**	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**20**	**0**	**8**	**24**	**28**	**460**	**440**	**900**

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT7201**	Virtual Instrumentation	PCC	3	0	0	3	3	40	60	100
2	**22MT7202**	Robotics and Machine Vision	PCC	3	1	0	4	4	40	60	100
3	**22MT73XX**	Professional Elective-6	PEC	3	0	0	3	3	40	60	100



4	22XX74XX	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5	22XX74XX	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
6	22MT7001	Robotics Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
7	22MT7701	Internship*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**15**	**1**	**4**	**20**	**22**	**360**	**340**	**700**

* - **Four weeks internship carries 2 credit and it will be done in before Semester VI summer vacation/placement training and same will be evaluated in Semester VII.**

SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
EEC COURSES (SE/AE)											
1	22MT8901	Project Work/Granted Patent	SEC	0	0	20	10	20	100	0	100
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**0**	**100**

Note:

1. **As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students' who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.**
2. **NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.**
3. **The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2022 – 23.**

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

Chairman

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	*Graphical Programming using* Virtual Instrumentation	*OEC*	*3*	*0*	*0*	*3*	*3*
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

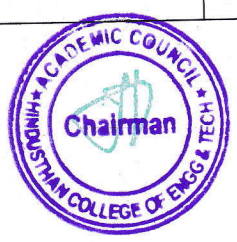
Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22MT7401	Project Management	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3



3	**22LS7403**	Indian ethos and Human values	OEC	3	0	0	3	3
4	**22LS7404**	Financial independence and management	OEC	3	0	0	3	3
5	**22LS7405**	Yoga for Human Excellence	OEC	3	0	0	3	3
6	**22LS7406**	Democracy and Good Governance	OEC	3	0	0	3	3
7	**22LS7407**	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

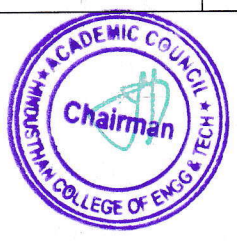
Vertical I Diversified Group	**Vertical II Industrial Engineering**	**Vertical III Management Studies**	**Vertical IV Manufacturing Process**	**Vertical V Vehicle Technology**	**Vertical VI Robotics and Automation**
22MT5301 Database Management System	**22MT5304** Product Design and Development	**22MT5307** Principles of Management	**22MT5310** Non-Traditional Machining Techniques	**22MT5313** Automobile System	**22MT5316** Mobile Robotics
22MT5302 Data Science	**22MT5305** Advance Manufacturing	**22MT5308** Disaster Management	**22MT5311** Computer Integrated Manufacturing	**22MT5314** Automotive Electronics	**22MT5317** Soft Robotics
22MT5303 Data Visualization	**22MT5306** Material Handling System	**22MT5309** Supply Chain Management	**22MT5312** Flexible Manufacturing System	**22MT5315** Electrical Vehicles	**22MT5318** Micro Robotics
22MT6301 Cyber Safety	**22MT6303** Non-Destructive Testing	**22MT6305** Economics and Cost Management	**22MT6307** Micro Manufacturing	**22MT6309** Hybrid Vehicles	**22MT6311** Textile Automation
22MT6302 AI for Mechatronics	**22MT6304** Design for Manufacturing and Assembly	**22MT6306** Digital Management	**22MT6308** Industrial 4.0	**22MT6310** Unmanned Aerial Vehicles	**22MT6312** Factory Automation
22MT7301 Optimization Techniques	**22MT7302** Diagnostics Techniques	**22MT7303** Marketing Management	**22MT7304** Rapid Prototyping	**22MT7305** Modern Vehicles Technology	**22MT7306** Automatic System

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Details of Vertical I: Diversified Group

S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
1	**22MT5301**	Database Management System	PEC	3	0	0	3	3



2	22MT5302	Data Science	PEC	3	0	0	3	3
3	22MT5303	Data Visualization	PEC	3	0	0	3	3
4	22MT6301	Cyber Safety	PEC	3	0	0	3	3
5	22MT6302	AI for Mechatronics	PEC	3	0	0	3	3
6	22MT7301	Optimization Techniques	PEC	3	0	0	3	3

Details of Vertical II: Industrial Engineering

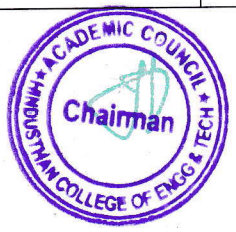
S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22MT5304	Product Design and Development	PEC	3	0	0	3	3
2	22MT5305	Material Handling System	PEC	3	0	0	3	3
3	22MT5306	Advance Manufacturing	PEC	3	0	0	3	3
4	22MT6303	Non-Destructive Testing	PEC	3	0	0	3	3
5	22MT6304	Design for Manufacturing and Assembly	PEC	3	0	0	3	3
6	22MT7302	Diagnostics Techniques	PEC	3	0	0	3	3

Details of Vertical III: Management Studies

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22MT5307	Principles of Management	PEC	3	0	0	3	3
2	22MT5308	Disaster Management	PEC	3	0	0	3	3
3	22MT5309	Supply Chain Management	PEC	3	0	0	3	3
4	22MT6305	Economics and Cost Management	PEC	3	0	0	3	3
5	22MT6306	Digital Management	PEC	3	0	0	3	3
6	22MT7303	Marketing Management	PEC	3	0	0	3	3

Details of Vertical IV: Manufacturing Process

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22MT5310	Non-Traditional Machining Techniques	PEC	3	0	0	3	3



2	**22MT5311**	Computer Integrated Manufacturing	PEC	3	0	0	3	3
3	**22MT5312**	Flexible Manufacturing System	PEC	3	0	0	3	3
4	**22MT6307**	Micro Manufacturing	PEC	3	0	0	3	3
5	**22MT6308**	Industrial 4.0	PEC	3	0	0	3	3
6	**22MT7304**	Rapid Prototyping	PEC	3	0	0	3	3

Details of Vertical V: Vehicle Technology

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5313**	Automobile System	PEC	3	0	0	3	3
2	**22MT5314**	Automotive Electronics	PEC	3	0	0	3	3
3	**22MT5315**	Electrical Vehicles	PEC	3	0	0	3	3
4	**22MT6309**	Hybrid Vehicles	PEC	3	0	0	3	3
5	**22MT6310**	Unmanned Aerial Vehicles	PEC	3	0	0	3	3
6	**22MT7305**	Modern Vehicles Technology	PEC	3	0	0	3	3

Details of Vertical VI: Robotics and Automation

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5316**	Mobile Robotics	PEC	3	0	0	3	3
2	**22MT5317**	Soft Robotics	PEC	3	0	0	3	3
3	**22MT5318**	Micro Robotics	PEC	3	0	0	3	3
4	**22MT6311**	Textile Automation	PEC	3	0	0	3	3
5	**22MT6312**	Factory Automation	PEC	3	0	0	3	3
6.	**22MT7306**	Automatic System	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

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Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE (MECHATRONICS)

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.
  Note: Each programme should provide verticals for minor degree

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5601**	Sem 5: Basics of Mechatronics System	MDC	3	0	0	3	3
2	**22MT6601**	Sem 6: Sensors and Interfacing	MDC	3	0	0	3	3
3	**22MT6602**	Sem6: Hydraulics and Pneumatics	MDC	3	0	0	3	3
4	**22MT7601**	Sem 7: PLC and SCADA	MDC	3	0	0	3	3
5	**22MT7602**	Sem 7: Robotics and its Applications	MDC	3	0	0	3	3
6	**22MT8601**	Sem 8: Design of Mechatronics System	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I **Fintech and Block Chain**	**Vertical II** **Entrepreneurship**	**Vertical III** **Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Sustainable infrastructure Development
Fundamentals of Investment	Introduction to Business Venture	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Team Building & Leadership Management for Business	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Creativity & Innovation in Entrepreneurship	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Principles of Marketing Management for Business	Green Technology
Introduction to Fintech	Human Resource Management for Entrepreneurs	Environmental Quality Monitoring and Analysis
	Financing New Business Ventures	

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VERTICALS FOR HONOURS DEGREE

Vertical I Industrial Automation	Vertical II Medical Mechatronics	Vertical III Applied Robotics
22MT5203 Concepts of Machines and Mechanisms	22MT5204 Robotics in Medicine	22MT5205 Robots and Systems in Smart Manufacturing
22MT6202 Drives and Actuators for Automation	22MT6204 Brain Computer Interface and its Applications	22MT6206 Medical Robotics
22MT6203 Power Electronics	22MT6205 Digital Image Processing	22MT6207 Agricultural Robotics and Automation
22MT7203 Advanced PLC	22MT7205 Radiological Equipment	22MT7207 Collaborative Robotics
22MT7204 Distributed Control System	22MT7206 Biomaterials	22MT7208 Robot Operating Systems
22MT8201 HMI & SCADA	22MT8202 Bionics	22MT8203 Humanoid Robotics

B.E (Hons) Mechatronics Engineering Specialization in Industrial Automation

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1	22MT5203	Sem 5: Concepts of Machines and Mechanisms	PC	3	0	0	3	3	40	60	100
2	22MT6202	Sem 6: Drives and Actuators for Automation	PC	3	0	0	3	3	40	60	100
3	22MT6203	Sem 6: Power Electronics	PC	3	0	0	3	3	40	60	100
4	22MT7203	Sem 7: Advanced PLC	PC	3	0	0	3	3	40	60	100
5	22MT7204	Sem 7: Distributed Control System	PC	3	0	0	3	3	40	60	100
6	22MT8201	Sem 8: HMI & SCADA	PC	3	0	0	3	3	40	60	100

B.E. (Hons) Mechatronics Engineering Specialization in Medical Mechatronics

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22MT5204	Sem 5: Robotics in Medicine	PC	3	0	0	3	3	40	60	100
2.	22MT6204	Sem 6: Brain Computer Interface and its	PC	3	0	0	3	3	40	60	100

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		Applications									
3.	22MT6205	Sem 6: Digital Image Processing	PC	3	0	0	3	3	40	60	100
4.	22MT7205	Sem 7: Radiological Equipments	PC	3	0	0	3	3	40	60	100
5.	22MT7206	Sem 7: Biomaterials	PC	3	0	0	3	3	40	60	100
6.	22MT8202	Sem 8: Bionics	PC	3	0	0	3	3	40	60	100

B.E (Hons) Mechatronics Engineering with Specialization in Applied Robotics

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22MT5205	Sem 5: Robots and Systems in Smart Manufacturing	PC	3	0	0	3	3	40	60	100
2.	22MT6206	Sem 6: Medical Robotics	PC	3	0	0	3	3	40	60	100
3.	22MT6207	Sem 6: Agricultural Robotics and Automation	PC	3	0	0	3	3	40	60	100
4.	22MT7207	Sem 7: Collaborative Robotics	PC	3	0	0	3	3	40	60	100
5.	22MT7208	Sem 7: Robot Operating Systems	PC	3	0	0	3	3	40	60	100
6.	22MT8203	Sem 8: Humanoid Robotics	PC	3	0	0	3	3	40	60	100

Note: Each programme should provide verticals for Honours degree

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SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	4	5	-	-	-	-	-	15
4	PCC	-	3	13	20	12	7	9	-	64
5	PEC	-	-	-	-	9	9	-	-	18
6	OEC	-	-	-	-	-	3	9	-	12
7	EEC	3	3	3	1	1	2	2	10	25
8	MCC		✓	✓	✓					
Total		**19**	**22**	**25**	**23**	**22**	**24**	**20**	**10**	**165**

CREDIT DISTRIBUTION R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	23	22	24	20	10	**165**

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22MA1101	MATRICES AND CALCULUS (Common to all Branches)	3	1	0	4

Course Objective

The learner should be able to

1. Construct the characteristic polynomial of a matrix and use it to identify Eigen values and Eigenvectors
2. Impart the knowledge of single variate calculus.
3. Familiarize the student with functions of several variables.
4. Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
5. Make a vector differential operator for vector function and theorems to solve engineering problems

Unit	Description	Instructional Hours
I	**Matrices** Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
II	**Single Variate Calculus** Rolle's Theorem – Lagrange's Mean Value Theorem - Maxima and Minima – Taylor's and Maclaurin's Series.	12
III	**Functions of Several Variables** Partial derivatives - Total derivative - Jacobians – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.	12
IV	**Integral Calculus** Double integrals in Cartesian coordinates – Area enclosed by plane curves (excluding surface area) – Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates.	12
V	**Vector Calculus** Gradient, divergence and curl vectors - Green's theorem - Stoke's and Gauss divergence theorem (statement only) for cubes only.	12
	Total Instructional Hours	60

Course Outcome

At the end of the course, the learner will be able to

CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.
CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve.
CO3: Able to use differential calculus ideas on several variable functions.
CO4: Apply multiple integral ideas in solving areas, volumes and other practical problems.
CO5: Apply the concept of vector calculus in two and three-dimensional spaces.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition, 2019.
T2 - K. P. Uma and S. Padma, "Engineering Mathematics I (Matrices and Calculus) ", Pearson Ltd,2022.

REFERENCE BOOKS:

R1 - Jerrold E. Marsden, Anthony Tromba, "Vector Calculus", W.H.Freeman, 2003-Strauss M. J, G. L Bradley and K. J .Smith, "Multivariable calculus", 6th edition, Prentice Hall, 2011.
R2 - Veerarajan T, "Engineering Mathematics", 5th edition, Mc Graw Hill Education(India) Pvt Ltd, New Delhi, 2016.
R3 - G. B. Thomas and R. L. Finney, "Calculus and Analytical Geometry", 9th Edition, Addison Wesley Publishing Company, 2016.

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	-	-	1	2	2	3	2
CO2	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO3	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO4	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO5	3	3	3	3	2	2	2	-	-	1	2	2	3	3
AVG	3	3	3	3	2.2	2	2			1	2	2	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22ME1201	ENGINEERING DRAWING (AGRI, , AERO, AUTO, CIVIL,MECH, MECT, FT)	1	2	0	3

Course Objective	**The learner should be able** 1. To gain the knowledge of Engineer's language of expressing complete details about objects and construction of conics and special curves. 2. To learn about the orthogonal projections of straight lines and planes. 3. To acquire the knowledge of projections of simple solid objects in plan and elevation. 4. To learn about the projection of sections of solids and development of surfaces. 5. To study the isometric projections of different objects.

Unit	Description	Instructional Hours
I	**PLANE CURVES** Importance of engineering drawing; drafting instruments; drawing sheets – layout and folding; Lettering and dimensioning, BIS standards, scales. Geometrical constructions, Engineering Curves Conic sections –Construction of ellipse, parabola and hyperbola by eccentricity method. Construction of cycloids and involutes of square and circle – Drawing of tangents and normal to the above curves.	12
II	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACES** Introduction to Orthographic projections- Projection of points. Projection of straight lines inclined to both the planes, Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method (First angle projections only).	12
III	**PROJECTIONS OF SOLIDS** Projection of simple solids like prisms, pyramids, cylinder, cone when the axis is perpendicular, and inclined to one plane by rotating object method.	12
IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of simple solids with their axis in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of truncated solids.	12
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections simple and truncated solids such as - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Free hand sketching of multiple views from a pictorial drawing. Basics of drafting using AutoCAD software.	12
	Total Instructional Hours	**60**

Course Outcome	At the end of the course, the learner will be able to CO1: Understand and interpret the engineering drawings in order to visualize the objects and draw the conics and special curves. CO2: Draw the orthogonal projections of straight lines and planes. CO3: Interpret the projections of simple solid objects in plan and elevation. CO4: Draw the projections of section of solids and development of surfaces of solids. CO5: Draw the isometric projections and the perspective views of different objects.

TEXT BOOK:

T1. K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5thedition New Age International
Publishers, New Delhi 2016.
T2. K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai 2016.

REFERENCES:

R1. BasantAgrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing company Limited,New Delhi,2013.
R2. N.S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University PRESS, India 2015.

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22ME1201- ENGINEERING DRAWING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	0	1	0	1	0	0	1	1	1
CO2	3	3	2	1	1	0	1	0	0	1	1	1
CO3	3	3	3	0	1	1	1	0	0	1	1	0
CO4	3	3	3	1	1	2	1	0	0	1	1	1
CO5	3	3	3	1	1	3	1	0	0	1	1	1
Avg	2.8	3	2.6	1	1	2	1	0	0	1	1	1

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22HE1151	ENGLISH FOR ENGINEERS (Common to all Branches)	2	0	2	3

Course Objective	**The student should be able** 1. To help the students of engineering and technology develop a strong base in the use of English. 2. To help learners use language effectively in professional writing. 3. To impart basic English grammar and essentials of important language skills 4. To impart knowledge about the importance of vocabulary and grammar 5. To develop the communication skills of the students in both formal and informal situations

Unit	Description	Instructional Hours
I	**Language Proficiency:** Parts of Speech, Degrees of Comparison, Abbreviation& Acronyms **Writing**: Process Description, Instructions. **Vocabulary** – Words on Environment. **Practical Component: Listening-** Watching Short Videos and answer the questions, **Speaking-** Self introduction , Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts / interviews **Reading-** Purpose of Reading - Churning & Assimilation, Interpreting Ideas - Interpreting Graphs in Technical Writing.	7+2
II	**Language Proficiency**: Types of Sentences, Framing Question, One Word Substitution **Writing:** Writing Checklist, Reading Comprehension. **Vocabulary–** Words on Entertainment. **Practical Component: Listening-**Comprehensions based on TED talks **Speaking-** Story Telling **Reading -** Skimming – Scanning – Reading: Scientific Texts	7+2
III	**Language Proficiency:** Tenses, Conditional Clause ('If' clause), Active and Passive voices, **Writing:** Formal letter (invitation, acceptance, decline, Congratulation) Cloze test. **Vocabulary** – Words on Tools. **Practical Component: Listening-**Listening pre-recorded English language learning programme **Speaking** - Just a minute **Reading-** Reading feature articles (from newspapers and magazines) -Reading to identify point of view and perspective (opinion pieces, editorials etc.)	5+4
IV	**Language Proficiency:** Subject Verb Concord, Articles, The Use of Prefixes and Suffixes **Writing:** Preparing Agenda &Minutes, Writing Recommendations. **Vocabulary–** Words on Engineering process. **Practical Component: Listening-**An interview with someone who works for recruitment personnel. **Speaking-**Presentation on a general topic. **Reading-** Reading Comprehension - Literary Texts.	5+4
V	**Language Proficiency:** Prepositions, Phrasal Verbs, Modal Auxiliaries, **Writing:** Letter to the Editor, Sequencing of Sentences **Vocabulary** –Words on Engineering material **Practical Component: Listening-** Listening- Comprehensions based on Nat Geo/Discovery channel videos **Speaking-** Preparing posters and presenting as a team. **Reading-** Biographies, Travelogues, Technical blogs.	6+3
	Total Instructional Hours	45

Course Outcome	**After completion of the course the learner will be able** CO1: Understand English and converse effectively. CO2: Enable the students to write coherently and cohesively. CO3: Enable the development of basic grammar to enhance language for a better communication CO4: Use suitable vocabulary and grammar with confidence and express their ideas both in speech and writing. CO5: Follow the etiquettes in formal and informal communication.

TEXT BOOKS:

T1- Raymond Murphy, "English Grammar in Use"-5th editionCambridgeUniversityPress, 2019.

T2-Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.

REFERENCE BOOKS:

R1- Kapoor A.N., Business Letters for Different Occasions, New Delhi: S. Chand & Co. Pvt. Ltd., 2012.

R2-RaymondMurphy, " English Grammar For ESL Learners - Premium Fourth Edition.

R3- McCarthy, Michael et.al (2011) English Vocabulary in Use – advanced, Cambridge University Press.

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PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	2	-	3	2	1	-	-
CO2	-	-	-	-	2	3	2	3	1	3	1	-	-	-
CO3	-	-	-	3		2	-	2	2	3	2	2	-	-
CO4	-	-	-	-	-	2	-	2	1	3	1	1	-	-
CO5	-	-	-	2	-	-	-	2	3	3	3	1	-	-
AVG	-	-	-	2.5	2	2.3	2	2.2	1.8	3	1.8	1.3	-	-

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22PH1153	**Physical properties of Materials (For B.E.AERO,AUTO, Mechanical & Mechatronics Engineering)**	2	0	2	3

Course Objective	The learner should be able to : 1. Have knowledge on the various phase diagrams of different materials and their applications 2. Acquire knowledge on various crystal structures. 3. Enhance the fundamental knowledge in mechanical properties of materials 4. Gain knowledge about thermal energy and their applications 5. Gain the knowledge on laser fundamentals and their applications

Unit	Description	Instructional Hours
I	**PHASE DIAGRAMS** Solid solutions - Hume Rothery's rules - the phase rule – singlecomponent system – binaryphase diagrams - isomorphous systems - the tie-line rule -the lever rule - application to isomorphous system – eutecticphase diagram - peritectic phase diagram.	6
II	**CONDENSED MATTER PHYSICS** Crystalline and Amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, characteristics of unit cell – number of atoms per unit cell, coordination number, atomic radius and Packing factor for SC, BCC, FCC and HCP structures – Miller indices and interplanar spacing.	6
III	**MECHANICAL PROPERTIES OF MATERIALS** Elasticity – Hooke's law –stress-strain diagram – bending moment – depression of a cantilever – derivation of young's modulus of the material of the beam by uniform bending - theory and experiment. Twisting couple - Torsion pendulum: theory and experiment. **Determination of Young's modulus by uniform bending method** **Determination of Rigidity modulus – Torsion pendulum**	12
IV	**THERMAL PHYSICS** Transfer of heat energy – thermal conduction, convection and radiation–Thermal expansion - expansion joints - bimetallic strips – thermal conductivity of a bad conductor: Lee's disc method to determine the thermal conductivity of bad conductor. Conduction through compound media (series and parallel) – applications: refrigerator and solar water heater. **Determination of thermal conductivity of a bad conductor – Lee's disc method** **V –Lab - https://vlab.amrita.edu/?sub=1&brch=194&sim=353&cnt=1**	9
V	**PHOTONICS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Type of lasers – Nd:YAG laser and CO_2laser. Laser Applications - Industrial applications of laser.Interference - Conditions for sustained Interference – air wedge and it's applications. **Determination of Wavelength and particle size using Laser** **Determination of thickness of a thin wire – Air wedge method** **V-Lab- https://vlab.amrita.edu/?sub=1&brch=189&sim=342&cnt=1**	12
	Total Instructional Hours	**45**

Course Outcome	At the end of the course, the learner will be able to CO1: Develop the various phase diagrams of different materials CO2: Relate the basics of crystals and their structures CO3: Illustrate the mechanical properties of materials CO4: Relate the thermal properties of materials and applications CO5:Familiarize the concepts of optics in the field of Engineering

TEXT BOOKS:

T1- Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.

T2 - Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1- Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010..

R2 - William D.Callister Jr, David G. Rethwisch "Materials Science and Engineering - An Introduction", Wiley India (P) Ltd., 8th Edition, 2018.

WEB REFERENCES

1.https://nptel.ac.in/courses/112108150/
2.https://en.wikipedia.org/wiki/Aircraft/
3. https://en.wikipedia.org/wiki/Aerospace_materials/
4. https://nptel.ac.in/courses/112106227/
5. https://nptel.ac.in/courses/104104085/

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PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	1	1	1	1	-	1	-	2	1
CO2	2	2	2	2	1	1	1	-	1	-	1	2
CO3	2	3	2	1	2	1	1	-	2	-	2	3
CO4	2	2	2	1	1	1	1	-	2	-	2	2
CO5	2	3	3	2	2	1	1	-	1	-	2	2
AVG	2	2.6	2.4	1.4	1.4	1	1	-	1.4	-	1.8	2.4

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22IT1151	PYTHON PROGRAMMING AND PRACTICES (AERO, AIML,CHEM,CIVIL,MECH,ECE,BME,MTS)	2	0	2	3

Course Objective	**The learner should be able** 1. To know the basics of algorithmic problem solving 2. To read and write simple Python programs 3. To develop Python programs with conditionals and loops and to define Python functions and call them 4. To use Python data structures — lists, tuples, dictionaries 5. To do input/output with files in Python

Unit	Description	Instructional Hours
I	**ALGORITHMIC PROBLEM SOLVING** 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: To find the Greatest Common Divisor (GCD)oftwo numbers, Fahrenheit to Celsius, Perform Matrix addition.**	5+4
II	**DATA, STATEMENTS,CONTROL FLOW** Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if -else), chained conditional (if –elif-else); Iteration: state, while, for, break, continue, pass; **Simple algorithms and programs: Area of the circle, check the given year is Leap year or not, Factorial of a Number.**	5+4
III	**FUNCTIONS, STRINGS** Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module. **Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs**	5+4
IV	**LISTS, TUPLES, DICTIONARIES** 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: List Manipulation, Finding Maximum in a List, String processing.**	5+4
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages **Illustrative programs: Reading writing in a file, word count, Handling Exceptions**	9
	Total Instructional Hours	**45**

Course Outcome	At the end of the course, the learner will be able to CO1: Develop algorithmic solutions to simple computational problems CO2: Read, write, execute by hand simple Python programs CO3: Structure simple Python programs for solving problems and Decompose a Python program into functions CO4: Represent compound data using Python lists, tuples, dictionaries CO5: Read and write data from/to files in Python Programs.

TEXT BOOKS:

T1: Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.6.2, Shroff Publishers, First edition (2017).

T2:S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd, 2019.

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REFERENCE BOOKS:

R1:CharlesDierbach, —Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition,2013.
R2:Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015
R3:Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson
India Education Services Pvt. Ltd., 2016

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3		2				-			2
CO2	2	3	3		2				2			2
CO3	2	3	3		2				3			2
CO4	2	3	3		2				2			2
CO5	2	3	3		2				3			2
AVG	2	3	3		2				2.4			2

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22HE1072	ENTREPRENEURESHIP AND INNOVATION (Common to all Branches)	1	0	0	1

Course Objectives	**The student should be made** 1. To acquire the knowledge and skills needed to manage the development of innovation. 2. To recognize and evaluate potential opportunities to monetize these innovations. 3. To plan specific and detailed method to exploit these opportunities. 4. To acquire the resources necessary to implement these plans. 5. To make students understand organizational performance and its importance.

Module	Description
1	**Entrepreneurial Thinking**
2	**Innovation Management**
3	**Design Thinking**
4	**Opportunity Spotting / Opportunity Evaluation**
5	**Industry and Market Research**
6	**Innovation Strategy and Business Models**
7	**Financial Forecasting**
8	**Business Plans/ Business Model Canvas**
9	**Entrepreneurial Finance**
10	**Pitching to Resources Providers / Pitch Deck**
11	**Negotiating Deals**
12	**New Venture Creation**
13	**Lean Start-ups**
14	**Entrepreneurial Ecosystem**
15	**Velocity Venture**
	TOTAL INSTRUCTIONAL HOURS **15**

Course Outcome	**At the end of the course, the learner will be able to** CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects. CO2: Understand the processes by which innovation is fostered, managed, and commercialized. CO3: Remember effectively and efficiently the potential of new business opportunities. CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness.. CO5: Develop a business model for a new venture, including revenue. Margins, operations, Working capital, and investment

TEXT BOOKS

T1:Arya Kumar"Entrepreneurship–CreatingandleadinganEntrepreneurialOrganization",Pearson,SecondEdition(2012).
T2: EmrahYayici"DesignThinkingMethodology", Artbiztech, FirstEdition(2016).

REFERENCE BOOKS

R1: Christopher Golis "Enterprise & Venture Capital", Allen &Unwin Publication, Fourth Edition (2007).
R2: ThomasLockWood&EdgerPapke"InnovationbyDesign",CareerPress.com,SecondEdition(2017).
R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, First Edition(2010).

WEB RESOURCES

W1:https://blof.forgeforward.in/tagged/startup-lessons
W2:https://blof.forgeforward.in/tagged/entrepreurship
W3:https://blof.forgeforward.in/tagged/minimum-viable-product
W4:https://blof.forgeforward.in/tagged/minimum-viable-product
W5:https://blof.forgeforward.in/tagged/innovation

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CO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	1	2
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

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Programme/ Semester	Course Code	Course Title	L	T	P	C
B.E./B.Tech/I	22HE1073	INTRODUCTION TO SOFT SKILLS	1	0	0	0

Course Objectives:

1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition, demonstration and practice.
2. To enhance the students ability to deal with numerical and quantitative skills.
3. To identify the core skills associated with critical thinking.
4. To develop and integrate the use of English language skills.

Unit	Description	Instructional Hours
I	**Lessons on excellence** Skill introspection, Skill acquisition, consistent practice	2
II	**Logical Reasoning** Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	**Quantitative Aptitude** Addition and Subtraction of bigger numbers - Square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts - Algebra and functions	11
IV	**Recruitment Essentials** Resume Building - Impression Management	2
V	**Verbal Ability** Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement – Punctuations	4
	Total Instructional Hours	30

Course Outcome	CO1	Students will analyze interpersonal communication skills. public speaking skills.
	CO2	Students will exemplify tautology, contradiction and contingency by logical thinking.
	CO3	Students will be able to develop an appropriate integral form to solve all sorts of quantitative problems.
	CO4	Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity.
	CO5	Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar.

CO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	1	2
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22MC1093	TAMIZHAR MARABHU	2	0	0	1

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தமிழர் மரபு

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அலகு I **மொழி மற்றும் இலக்கியம்:** 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II **மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை:** 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:** 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV **தமிழர்களின் திணைக் கோட்பாடுகள்:** 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:** 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City .Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22MC1094	**HERITAGE OF TAMIL (Common to all Branches)**	2	0	0	1

Course Objective	**The learner should be able to** 1. Introduce students to the great History of Tamil literature. 2. Establish the heritage of various forms of Rock art and Sculpture art. 3. To study and understand the various folk and Martial arts of Tamil culture 4. Introduce students to Ancient Tamil concepts to understand the richness of Tamil literature. 5. To learn about the various influences or impacts of Tamil language in Indian culture.

Unit	Description	Instructional Hours
I	**Language and Literature** Language families in India – Dravidian Languages – Tamil as a classical language – Classical Literature in Tamil- Secular nature of Sangam Literature – Distributive justice in Sangam Literature – Management principles in Thirukural – Tamil epics and impacts of Buddhism & Jainism in Tamil and Bakthi literature of Azhwars and Nayanmars – Forms of minor poetry _ Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidasan.	6
II	**Heritage _ Rock Art Paintings to Modern Art – Sculpture** Hero Stone to Modern Sculpture – Bronze icons – Tribes and their handcrafts - Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar statue at Kanyakumari, Making of musical instruments – Mridangam, Parai, Yazh and Nadhaswaram - Role of Temples in social and economic life of Tamils.	6
III	**Folk and Martial Arts** Therukoothu, Karagattem, Villupattu, Kaniyankoothu, Oyilattam, Leather puppertry, Silambattam.,Valari Tiger dance – Sports and Games of Tamils.	6
IV	**Thinai Concept of Tamils** Flora and Fauna of Tamils – Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram concept of Tamils – Education and Literacy during Sangam Age - Ancient cities and ports of Sangam age – Exporot and Import during Sangam age – Overseas conquest of Cholas.	6
V	**Contribution of Tamils to Indian National Movement and Indian Culture** Contribution of Tamils to Indian freedom struggle – The cultural influence of Tamils over the other parts of India – Self respect movement – Role of Siddha Medicine in indigenous systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil books.	6
	Total Instructional Hours	**30**

Course Outcome	**At the end of the course, the learner will be able to** CO1: Learn about the works pertaining to Sangam age CO2: Aware of our Heritage in art from Stone sculpture to Modern Sculpture. CO3Appreciate the role of Folk arts in preserving, sustaining and evolution of Tamil culture. CO4: Appreciate the intricacies of Tamil literature that had existed in the past. CO5: Understand the contribution of Tamil Literature to Indian Culture

TEXT BOOKS:

T1- Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

T2- Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.

T3- Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).

REFERENCE BOOKS:

R1-The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)

R2- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu TextBookand Educational Services Corporation, Tamil Nadu)

R3-Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

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PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12
CO1	2	3	3	-	-	-	-	-	2			2
CO2	2	3	3	-	-	-	-	-	2			2
CO3	2	3	3	-	-	-	-	-	2			2
CO4	2	3	-	-	-	-	-	-	2			2
CO5	2	3	-	-	-	-	-	-	2			2
AVG	2	3	1.8	-	-	-	-	-	2			2

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	**22MC1095**	**UNIVERSAL HUMAN VALUES (COMMON TO ALL BRANCHES)**	2	0	0	0

Course Objectives	**The student should be made** 1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. 2. TofacilitatethedevelopmentofaHolisticperspectiveamongstudentstowardslifeandprofession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. 3. TohighlightplausibleimplicationsofsuchaHolisticunderstandingIntermsofethicalhumanconduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Unit	Description	Instructional Hours
I	**Introduction to Value Education** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations	6
II	**Harmony in the Human Being and Harmony in the Family** Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self- Harmony of the Self with the Body - Programme to ensure self-regulation and Health	6
III	**Harmony in the Family and Society** Harmony in the Family – the Basic Unit of Human Interaction. Values in Human to Human Relationship 'Trust' – the Foundational Value in Relationship Values in Human to Human Relationship 'Respect' – as the Right Evaluation Understanding Harmony in the Society	6
IV	**Harmony in the Nature / Existence** Understanding Harmony in the Nature.Inter connectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature- Understanding Existence as Co-existence of mutually interacting units in all pervasivespace Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence. Vision for the Universal Human Order	6
V	**Implications of the Holistic Understanding – a Look at Professional Ethics** Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies Strategies for Transition towards Value-based Life and Profession	6
	Total Instructional Hours	**30**

Course Outcome	At the end of the course, the learner will be able CO1: To become more aware of holistic vision of life - themselves and their surroundings. CO2: To become more responsible in life, in the Society and in handling problems with sustainable Solutions. CO3: To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior. CO4: To able to apply what have learnt to their own self in different day-to-day settings in real life and in handling problems with sustainable solutions. CO5: To develop competence and capabilities for maintaining Health and Hygiene.

Chairman - BoS
MCT - HiCET

Chairman

Dean (Academics)
HiCET

Reference Books:

R1- A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

R2- Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2

R3-Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

R4- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

CO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	2	-	-	-	2	-	-	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2
AVG	2	3	3	-	2	-	-	-	2	-	-	2

Chairman - BoS
MCT - HiCET

ACADEMIC COUNCIL * MINOS * THAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

Department of Mechatronics Engineering

Syllabus Revision carried out in 2024-2025 ODD Semester

2022 Regulation – 2023 Batch III semester- Syllabus revision

S. NO	YEAR	SEM	COURSE CODE& NAME	SUGGESTION BY EXPERTS	EXISTING CONTENT	REVISED CONTENT	TYPE OF REVISION	% OF REVISION
1	II	III	22MT3251 - MANUFACTURING PROCESS	Dr. Thyla suggested to replace the case studies in specific	Erection of Boilers and manufacturing of sports equipment's and products	Case Study 2: Manufacturing of Aerospace components. Case Study 3: Manufacturing of Robotic Assembly.	INSERTION	10%
							Total Percentage Changes	**10%**

New Course Introduced (2022 Regulation) – 2023 Batch III semester

S. No	Regulation	Course Code with Name	Credits
NIL			

Chairman, Board of studies

Chairman - BoS
MCT - HiCET

Dean Academics

Dean (Academics)
HiCET

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. MECHATRONICS ENGINEERING (UG)

REGULATION-2022

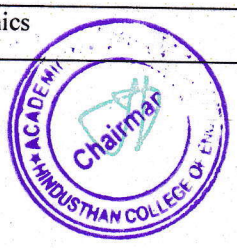
For the students admitted during the academic year 2023-2024 and onwards

SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2	22ME1201	Engineering Drawing	ESC	1	2	0	3	5	40	60	100
THEORY WITH LAB COMPONENT											
3	22HE1151	English for Engineers	HSC	2	0	2	3	4	40	60	100
4	22PH1153	Physical Properties of Materials	BSC	2	0	2	3	4	50	50	100
5	22IT1151	Python Programming and Practices	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
7	22HE1073	Introduction to Soft Skills	SEC	1	0	0	0	1	100	0	100
MANDATORY COURSE											
8.	22MC1093/ 22MC1094	தமிழர் மரபு / Heritage of Tamils	MC	2	0	0	1	2	100	0	100
9.	22MC1095	Universal Human Values	MC	2	0	0	0	2	40	60	100
			TOTAL	**15**	**3**	**6**	**18**	**27**	**470**	**330**	**800**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA2101	Differential Equations and Complex Analysis	BSC	3	1	0	4	4	40	60	100
2	22PH2102	Applied Mechanics	BSC	2	0	0	2	2	40	60	100



3	**22CY2101**	Environmental Studies	ESC	2	0	0	2	2	40	60	100
THEORY WITH LAB COMPONENT											
4	**22HE2151**	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
5	**22CY2152**	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
6	**22MT2251**	Fundamentals of Mechatronics	PCC	2	0	2	3	4	50	50	100
PRACTICAL COURSES											
7	**22ME2001**	Engineering Practices	ESC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	**22HE2071**	Design Thinking	AEC	1	0	2	2	3	100	0	100
9	**22HE2073**	Soft Skills and Aptitude -I	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10.	22MC2094/ 22MC2095	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	MC	2	0	0	1	2	100	0	100
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							-
			TOTAL	**17**	**1**	**12**	**23**	**30**	**630**	**370**	**1000**

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MA3105**	Fourier Series and Transforms	BSC	3	1	0	4	4	40	60	100
2	**22MT3201**	Industrial Motor Control	ESC	3	0	0	3	3	40	60	100
3	**22MT3202**	Solid and Fluid Mechanics	PCC	3	1	0	4	4	40	60	100
4	**22MT3203**	Digitronics	PCC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
5	**22MT3251R**	Manufacturing Process	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
6	**22MT3001**	Industrial Motor Control Lab	ESC	0	0	4	2	4	60	40	100
7	**22MT3002**	Solid and Fluid Mechanics Lab	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	**22HE3071**	Soft Skills and Aptitude -II	SEC	1	0	0	1	1	100	0	100

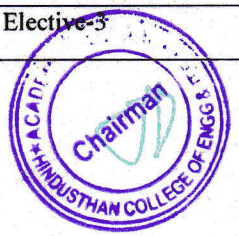
9	**22MT3901**	Mini Project	AEC	0	0	4	2	4	60	40	100
MANDATORY COURSE											
10	**22MC3091**	Essence of Indian Traditional Knowledge	MC	1	0	0	0	1	0	100	100
			TOTAL	**16**	**3**	**14**	**25**	**33**	**490**	**510**	**1000**

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22HE4101**	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2	**22MT4201**	Processor and controller	PCC	3	0	0	3	3	40	60	100
3	**22MT4202**	Metrology and Measurements	PCC	3	0	0	3	3	40	60	100
4	**22MT4203**	Theory of Machines	PCC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
5	**22MT4251**	Sensors and Transducers	PCC	2	0	2	3	4	50	50	100
6	**22MT4252**	Fluid Power System	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
7	**22MT4001**	Processor and controller Laboratory	PCC	0	0	4	2	4	60	40	100
8	**22MT4002**	CAD Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	**22HE4071**	Soft Skills and Aptitude -III	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10	**22MC4091**	Indian Constitution	MC	1	0	0	0	1	0	100	100
			TOTAL	**17**	**1**	**12**	**23**	**30**	**480**	**520**	**1000**

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT5201**	CNC Technology	PCC	3	0	0	3	3	40	60	100
2	**22MT5202**	Control System	PCC	3	1	0	4	4	40	60	100
3	**22MT53XX**	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4	**22MT53XX**	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5	**22MT53XX**	Professional Elective-3	PEC	3	0	0	3	3	40	60	100



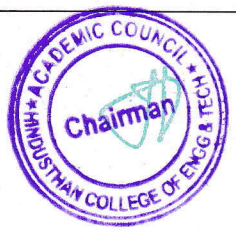
THEORY WITH LAB COMPONENT											
6	**22MT5251**	Embedded System	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
7	**22MT5001**	CNC laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	**22HE5071**	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**18**	**0**	**6**	**21**	**25**	**410**	**390**	**800**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT6201**	Industrial Automation	PCC	3	0	0	3	3	40	60	100
2	**22HE6101**	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3	**22MT63XX**	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4	**22MT63XX**	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5	**22XX64XX**	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6	**22XX64XX**	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	**22MT6001**	Industrial Automation Laboratory	PCC	0	0	4	2	4	60	40	100
8	**22MT6002**	CAM Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	**22HE6071**	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**20**	**0**	**8**	**24**	**28**	**460**	**440**	**900**

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT7201**	Virtual Instrumentation	PCC	3	0	0	3	3	40	60	100
2	**22MT7202**	Robotics and Machine Vision	PCC	3	1	0	4	4	40	60	100
3	**22MT73XX**	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
4	**22XX74XX**	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5	**22XX74XX**	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											



6	**22MT7001**	Robotics Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
7	**22MT7701**	Internship*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**15**	**1**	**4**	**20**	**22**	**360**	**340**	**700**

* - **Four weeks internship carries 2 credit and it will be done in before Semester VI summer vacation/placement training and same will be evaluated in Semester VII.**

SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
EEC COURSES (SE/AE)											
1	**22MT8901**	Project Work/Granted Patent	SEC	0	0	20	10	20	100	0	100
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**0**	**100**

Note:

4. **As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students' who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.**
5. **NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.**
6. **The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2022 – 23.**

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22AI6451**	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	**22CS6451**	Blockchain Technology	OEC	2	0	2	4	3
3	**22EC6451**	Cyber security	OEC	2	0	2	4	3
4	**22EC6452**	IoT Concepts and Applications	OEC	2	0	2	4	3
5	**22IT6451**	Data Science and Analytics	OEC	2	0	2	4	3
6	**22BM6451**	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22MT7401	Project Management	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3

HINDUSTHAN COLLEGE OF ENGG & TECH. A.C. Chairman

4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Diversified Group	Vertical II Industrial Engineering	Vertical III Management Studies	Vertical IV Manufacturing Process	Vertical V Vehicle Technology	Vertical VI Robotics and Automation
22MT5301 Database Management System	22MT5304 Product Design and Development	22MT5307 Principles of Management	22MT5310 Non-Traditional Machining Techniques	22MT5313 Automobile System	22MT5316 Mobile Robotics
22MT5302 Data Science	22MT5305 Advance Manufacturing	22MT5308 Disaster Management	22MT5311 Computer Integrated Manufacturing	22MT5314 Automotive Electronics	22MT5317 Soft Robotics
22MT5303 Data Visualization	22MT5306 Material Handling System	22MT5309 Supply Chain Management	22MT5312 Flexible Manufacturing System	22MT5315 Electrical Vehicles	22MT5318 Micro Robotics
22MT6301 Cyber Safety	22MT6303 Non-Destructive Testing	22MT6305 Economics and Cost Management	22MT6307 Micro Manufacturing	22MT6309 Hybrid Vehicles	22MT6311 Textile Automation
22MT6302 AI for Mechatronics	22MT6304 Design for Manufacturing and Assembly	22MT6306 Digital Management	22MT6308 Industrial 4.0	22MT6310 Unmanned Aerial Vehicles	22MT6312 Factory Automation
22MT7301 Optimization Techniques	22MT7302 Diagnostics Techniques	22MT7303 Marketing Management	22MT7304 Rapid Prototyping	22MT7305 Modern Vehicles Technology	22MT7306 Automatic System

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Details of Vertical I: Diversified Group

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22MT5301	Database Management System	PEC	3	0	0	3	3
2	22MT5302	Data Science	PEC	3	0	0	3	3

3	**22MT5303**	Data Visualization	PEC	3	0	0	3	3
4	**22MT6301**	Cyber Safety	PEC	3	0	0	3	3
5	**22MT6302**	AI for Mechatronics	PEC	3	0	0	3	3
6	**22MT7301**	Optimization Techniques	PEC	3	0	0	3	3

Details of Vertical II: Industrial Engineering

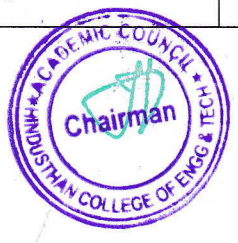
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5304**	Product Design and Development	PEC	3	0	0	3	3
2	**22MT5305**	Material Handling System	PEC	3	0	0	3	3
3	**22MT5306**	Advance Manufacturing	PEC	3	0	0	3	3
4	**22MT6303**	Non-Destructive Testing	PEC	3	0	0	3	3
5	**22MT6304**	Design for Manufacturing and Assembly	PEC	3	0	0	3	3
6	**22MT7302**	Diagnostics Techniques	PEC	3	0	0	3	3

Details of Vertical III: Management Studies

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5307**	Principles of Management	PEC	3	0	0	3	3
2	**22MT5308**	Disaster Management	PEC	3	0	0	3	3
3	**22MT5309**	Supply Chain Management	PEC	3	0	0	3	3
4	**22MT6305**	Economics and Cost Management	PEC	3	0	0	3	3
5	**22MT6306**	Digital Management	PEC	3	0	0	3	3
6	**22MT7303**	Marketing Management	PEC	3	0	0	3	3

Details of Vertical IV: Manufacturing Process

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5310**	Non-Traditional Machining Techniques	PEC	3	0	0	3	3
2	**22MT5311**	Computer Integrated Manufacturing	PEC	3	0	0	3	3
3	**22MT5312**	Flexible Manufacturing System	PEC	3	0	0	3	3
4	**22MT6307**	Micro Manufacturing	PEC	3	0	0	3	3



5	**22MT6308**	Industrial 4.0	PEC	3	0	0	3	3
6	**22MT7304**	Rapid Prototyping	PEC	3	0	0	3	3

Details of Vertical V: Vehicle Technology

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5313**	Automobile System	PEC	3	0	0	3	3
2	**22MT5314**	Automotive Electronics	PEC	3	0	0	3	3
3	**22MT5315**	Electrical Vehicles	PEC	3	0	0	3	3
4	**22MT6309**	Hybrid Vehicles	PEC	3	0	0	3	3
5	**22MT6310**	Unmanned Aerial Vehicles	PEC	3	0	0	3	3
6	**22MT7305**	Modern Vehicles Technology	PEC	3	0	0	3	3

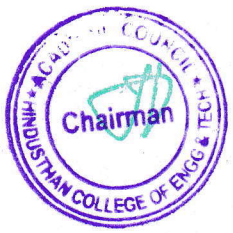
Details of Vertical VI: Robotics and Automation

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5316**	Mobile Robotics	PEC	3	0	0	3	3
2	**22MT5317**	Soft Robotics	PEC	3	0	0	3	3
3	**22MT5318**	Micro Robotics	PEC	3	0	0	3	3
4	**22MT6311**	Textile Automation	PEC	3	0	0	3	3
5	**22MT6312**	Factory Automation	PEC	3	0	0	3	3
6.	**22MT7306**	Automatic System	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).



VERTICALS FOR MINOR DEGREE (MECHATRONICS)

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

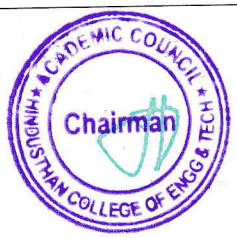
  Note: Each programme should provide verticals for minor degree

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5601**	Sem 5: Basics of Mechatronics System	MDC	3	0	0	3	3
2	**22MT6601**	Sem 6: Sensors and Interfacing	MDC	3	0	0	3	3
3	**22MT6602**	Sem6: Hydraulics and Pneumatics	MDC	3	0	0	3	3
4	**22MT7601**	Sem 7: PLC and SCADA	MDC	3	0	0	3	3
5	**22MT7602**	Sem 7: Robotics and its Applications	MDC	3	0	0	3	3
6	**22MT8601**	Sem 8: Design of Mechatronics System	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I **Fintech and Block Chain**	**Vertical II** **Entrepreneurship**	**Vertical III** **Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Sustainable infrastructure Development
Fundamentals of Investment	Introduction to Business Venture	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Team Building & Leadership Management for Business	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Creativity & Innovation in Entrepreneurship	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Principles of Marketing Management for Business	Green Technology
Introduction to Fintech	Human Resource Management for Entrepreneurs	Environmental Quality Monitoring and Analysis
	Financing New Business Ventures	



VERTICALS FOR HONOURS DEGREE

Vertical I Industrial Automation	Vertical II Medical Mechatronics	Vertical III Applied Robotics
22MT5203 Concepts of Machines and Mechanisms	22MT5204 Robotics in Medicine	22MT5205 Robots and Systems in Smart Manufacturing
22MT6202 Drives and Actuators for Automation	22MT6204 Brain Computer Interface and its Applications	22MT6206 Medical Robotics
22MT6203 Power Electronics	22MT6205 Digital Image Processing	22MT6207 Agricultural Robotics and Automation
22MT7203 Advanced PLC	22MT7205 Radiological Equipment	22MT7207 Collaborative Robotics
22MT7204 Distributed Control System	22MT7206 Biomaterials	22MT7208 Robot Operating Systems
22MT8201 HMI & SCADA	22MT8202 Bionics	22MT8203 Humanoid Robotics

B.E (Hons) Mechatronics Engineering Specialization in Industrial Automation

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1	22MT5203	Sem 5: Concepts of Machines and Mechanisms	PC	3	0	0	3	3	40	60	100
2	22MT6202	Sem 6: Drives and Actuators for Automation	PC	3	0	0	3	3	40	60	100
3	22MT6203	Sem 6: Power Electronics	PC	3	0	0	3	3	40	60	100
4	22MT7203	Sem 7: Advanced PLC	PC	3	0	0	3	3	40	60	100
5	22MT7204	Sem 7: Distributed Control System	PC	3	0	0	3	3	40	60	100
6	22MT8201	Sem 8: HMI & SCADA	PC	3	0	0	3	3	40	60	100

B.E. (Hons) Mechatronics Engineering Specialization in Medical Mechatronics

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22MT5204	Sem 5: Robotics in Medicine	PC	3	0	0	3	3	40	60	100

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2.	22MT6204	Sem 6: Brain Computer Interface and its Applications	PC	3	0	0	3	3	40	60	100
3.	22MT6205	Sem 6: Digital Image Processing	PC	3	0	0	3	3	40	60	100
4.	22MT7205	Sem 7: Radiological Equipments	PC	3	0	0	3	3	40	60	100
5.	22MT7206	Sem 7: Biomaterials	PC	3	0	0	3	3	40	60	100
6.	22MT8202	Sem 8: Bionics	PC	3	0	0	3	3	40	60	100

B.E (Hons) Mechatronics Engineering with Specialization in Applied Robotics

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22MT5205	Sem 5: Robots and Systems in Smart Manufacturing	PC	3	0	0	3	3	40	60	100
2.	22MT6206	Sem 6: Medical Robotics	PC	3	0	0	3	3	40	60	100
3.	22MT6207	Sem 6: Agricultural Robotics and Automation	PC	3	0	0	3	3	40	60	100
4.	22MT7207	Sem 7: Collaborative Robotics	PC	3	0	0	3	3	40	60	100
5.	22MT7208	Sem 7: Robot Operating Systems	PC	3	0	0	3	3	40	60	100
6.	22MT8203	Sem 8: Humanoid Robotics	PC	3	0	0	3	3	40	60	100

Note: Each programme should provide verticals for Honours degree

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SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	4	5	-	-	-	-	-	15
4	PCC	-	3	13	20	12	7	9	-	64
5	PEC	-	-	-	-	9	9	-	-	18
6	OEC	-	-	-	-	-	3	9	-	12
7	EEC	3	3	3	1	1	2	2	10	25
8	MCC		✓	✓	✓					
Total		**19**	**22**	**25**	**23**	**22**	**24**	**20**	**10**	**165**

CREDIT DISTRIBUTION R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	23	22	24	20	10	**165**

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B.E	22MA3105	FOURIER SERIES AND TRANSFORMS (MECT, MECH)	3	1	0	4

Course Objective	**The learner should be able to** 1. Analyze the Fourier series which is central to many applications in engineering. 2. Familiarize the effective tools for the solutions of one dimensional boundary value problems. 3. Impart the knowledge of the solutions of two dimensional heat equations. 4. Explore the Fourier transform techniques in various situations. 5. Explore the Z transform techniques for discrete time systems.	
Unit	**Description**	**Instructional Hours**
I	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Change of Interval - RMS Value - Parseval's Identity - Half Range Sine and Cosine Series - Harmonic analysis.	**12**
II	**BOUNDARY VALUE PROBLEMS** Classification of PDE - Problems based on one dimensional wave equation - One dimensional equation of heat conduction (excluding insulated edges).	**12**
III	**TWO DIMENSIONAL HEAT EQUATIONS** General and Steady state solution of two dimensional equation of heat conduction in infinite plate and semi circular plate.	**12**
IV	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier Sine and Cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity (Statement only).	**12**
V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS** Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction) – Convolution theorem(excluding proof)– Solution of difference equations using Z – transform	**12**
	Total Instructional Hours	**60**
Course Outcome	**At the end of the course, the learner will be able to** CO1: Apply the principles of Fourier series which helps them to solve physical problems of engineering. CO2: Apply the Fourier series in solving the boundary value problems. CO3: Apply the Fourier series in solving the two dimensional heat equations. CO4: Compute the Fourier transforms techniques which extend its applications. CO5: Acquire knowledge about the Z- transforms for analyzing discrete-time signals and systems	

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2023

T2 - Bali. N.P and Manish Goyal & Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2015

REFERENCE BOOKS :

R1 - Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.

R2 - Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2018.

R3 - Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	-	-	1	2	2	3	2
CO2	3	3	3	3	3	1	1	-	-	1	2	2	3	2
CO3	3	3	3	3	2	1	1	-	-	1	2	2	3	2
CO4	3	3	3	2	2	1	2	-	-	1	2	2	2	2
CO5	3	3	3	2	2	1	2	-	-	1	3	2	2	2
AVG	3	3	3	2.6	2.4	1	1.4	-	-	1	2.2	2	2.6	2

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Programme	Course code	Name of the course	L	T	P	C
B.Tech	22MT3201	INDUSTRIAL MOTOR CONTROL	3	0	0	3

The student should be made

Course Objective

1	To identify the control circuit components used in electrical circuit
2	To illustrate the basic control circuits for industrial motors
3	To select the suitable starting and braking methods for electrical machines
4	To study the principle and construction of different Motors.
5	To impart knowledge on operation of inverters and converters and Power electronics Applications

Unit	Description	Instructional Hours
I	**BASIC CONTROL CIRCUIT COMPONENTS** General Principles of Motor Control - Symbols and Schematic Diagrams – Manual Starters, AC starters and DC starters (2 point 3 point) - overload relays - Relays, Contactors- Basic Control Circuits components and switches.	9
II	**BASIC CONTROLCIRCUITS** START - STOP Push Button Control - Multiple Push Button Stations – Forward - Reverse Control - Jogging and Inching - Timing Relays - Sequence Control	9
III	**STARTING AND BRAKING METHODS** DOL Starter - Automatic Auto Transformer Starter, Star/Delta Starter (Semi-Automatic and Automatic) Three Step Rotor Resistance Starter - Plugging - Dynamic Braking	9
IV	**DC AND AC MOTORS** DC shunt Motor, Dc series motor, Single phase Induction motor, Three phase Induction Motor, Construction and operation of synchronous motor, AC servomotor, Linear induction motor and stepper motors - Case Studies : Under water Motor Application	9
V	**POWER ELECTRONICS APPLICATIONS** Half bridge and Full bridge: Single phase and Three phase converter - Choppers types - Serial and Parallel Inverter - Single phase and Three phase cycloconverters – Applications - Induction heating, UPS.	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Recognize the control circuit components used in electrical wiring
CO2	Apply the control circuits in industrial motor control
CO3	Sketch the control circuits for Starting and Braking Methods
CO4	Understand the basic operation of Motors and can select special motors for different purpose.
CO5	Ability to choose the converters and inverters for real time applications

TEXT BOOK:

T1	Stephen L. Herman, "Understanding Motor Controls" Third Edition. Cengage Learning,2017.
T2	M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, fourth Edition, New Delhi, 2014

REFERENCES:

R1	Stephen L. Herman, "Industrial Motor Control" Seventh Edition, CengageLearning,2013
R2	Bhattacharya.S.K & Brijinder Singh, "Control of Electrical Machines", 2nd Edition, New Age International (P) Ltd., New Delhi,2010.
R3	M.D. Singh and K.B. Khanchandani, "Power Electronics," 2nd Edition McGraw Hill India,2013.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	1	3	3	2				2			2	2	2
CO2	3	1	2	1	2							2	2	1
CO3	2	1	1	2								2	1	1
CO4	1	1	2	2		2			2		2	3	2	1
CO5	2	3	2	2									2	2
AVG	2.2	1.4	2	2	0.8	0.4	-	-	0.8	-	0.4	1.8	1.8	1.4
1-low, 2-medium, 3-high, '-"- no correlation Note: The average value of this course to be used for program articulation matrix.														

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Programme	Course code	Name of the course	L	T	P	C
B.Tech	22MT3202	SOLID AND FLUID MECHANICS	3	1	0	4

The student should be made

Course Objective

1	Describe the concepts of Forces, Equilibrium, Stress, Strain, Bending moment and torsion.
2	Apply these concepts to simple problems in beams and Columns
3	Able to understand the fundamentals of fluid flow.
4	Able to understand the effects of fluid flow through pipes.
5	Able to understand the types of turbines and pumps.

Unit	Description	Instructional Hours
I	**DEFORMATION OF SOLIDS AND BENDING OF BEAMS** Concept of stress and strain – Normal and shear stresses – Simple and compound Stresses - Elasticity and elastic moduli – Poisson's ratio – Types of loads, Supports & beams - Concept of Shear Force and Bending Moment – Shear force and Bending moment diagrams for simply supported and cantilever beams.	9+3
II	**DEFLECTION OF BEAMS AND COLUMNS** Double Integration method – Macaulay's method for computation of slopes and deflections in beams - Short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine formula for columns.	9+3
III	**FLUID PROPERTY AND FLOW CHARACTERISTICS** Surface tension – Capillarity – Viscosity – Newton's law – Fluid pressure and pressure head - Fluid velocity – Uniform and steady flow – Reynolds number - Classification as laminar and turbulent flow – Continuity equation.	9+3
IV	**FLOW DYNAMICS AND MEASUREMENT IN PIPE NETWORKS** Euler's and Bernoulli's Equations – Manometer, Venturi meter and orifice meter - Pressure losses along the flow – Categorisation into minor losses - Flow through circular pipes – Statement of Darcy – Weisbach equation – Friction factor – Pipes in series and parallel.	9+3
V	**TURBINES AND PUMPS** Introduction and Classification of Turbines – Specific Speed – Turbine characteristics Speed Governance – Pumps - Centrifugal Pumps – Impeller Blade Profiles – Pump characteristics – Efficiency – Reciprocating Pumps – Classification.	9+3
	Total Instructional Hours	60

Course Outcome

CO1	Outline the fundamental concepts of deformation of solids and its effects on beams. (Apply)
CO2	Determine the effects of shear stresses on beams and effect of load on columns. (Apply)
CO3	Explain the fundamental concepts of fluid property and basic equations. (Understand)
CO4	Describe the effects of fluid flow inside the pipes. (Understand)
CO5	Explain the types of turbines and pumps and calculating the efficiency (Apply)

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TEXT BOOK:	
T1	R.K., Bansal, A text book on Fluid Mechanics & Hydraulic Mechanics,- M/s. Laxmi Publications (P) Ltd, 2010.
T2	Er. R K Rajput, A Textbook of Strength of Materials (Mechanics of Solids) SI Units, S Chand Publishing,2018
REFERENCES:	
R1	Prof K. L. Kumar, 'Engineering Fluid Mechanics' SI units, S. Chand & Company Ltd, 2009.
R2	Dr.R.K. Bansal, Strength of Materials, M/s. Laxmi Publications (P) Ltd, 2018.

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	2	1	1			1			2		1
CO2	3	2	2	3	1	1			1			2	2	1
CO3	3	2	2	3	1	1			1			2	1	1
CO4	3	2	2	3	1	1			1			2	1	2
CO5	3	2	2	3	1	1			1			2	2	2
AVG	3	2	2	2.8	1	1	-	-	1	-	-	2	1.2	1.4

1-low, 2-medium, 3-high, '-"- no correlation
Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B.Tech	22MT3203	DIGITRONICS	3	1	0	4

The student should be made

Course Objective

1. To impart knowledge about the fundamentals of logic gates and boolean algebra
2. To learn various combinational and sequential circuits
3. To describe various flip-flops used in sequential circuits
4. To familiarize the basics of synchronous and asynchronous circuits
5. To introduce digital concepts in mechatronics applications

Unit	Description	Instructional Hours
I	**LOGIC GATES AND MINIMIZATION TECHNIQUES** Minimization Techniques: Boolean Algebra - Simplification of Boolean Functions - Minterm - Maxterm - Sum of Product - Product of Sum - Karnaugh Map - Quine McClusky Method. Logic Gates: Logic Functions using Gates - NAND - NOR Implementations - Multi Level Gate Implementations - Multi Output Gate Implementations	9+3
II	**COMBINATIONAL CIRCUITS** Half and Full Adders - Half and Full Subtractors - Code Converters - Encoder - Decoder - Multiplexer - Demultiplexer - Carry Look Ahead Adder - Magnitude Comparator.	9+3
III	**SEQUENTIAL CIRCUITS** Latches - Flip-Flops SR, JK, D, T, and Master - Slave. Asynchronous & Synchronous Up/Down Counters. Design of Synchronous Counters: State Diagram - State Table - State Minimization - State Assignment - Excitation Table and Maps - Modulo-n Counter.	9+3
IV	**MEMORY DEVICES** Classifications of Memories - ROM Organization - RAM Organization. Programmable Logic Devices - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA).	9+3
V	**APPLICATIONS** Digital Electronics on Engine Management - FADEC. Industrial Automation - Process Monitoring and Control - Distributed Control Systems in Robotics - 3C - Communications, Command and Control - Automotive Industry - Electronic Control Unit.	9+3
	Total Instructional Hours	60

Course Outcome

CO1	Design logic circuits and to evaluate its function realizations using gates
CO2	Develop combinational and sequential circuit systems using flip flops
CO3	Apply the minimization techniques in sequential circuits
CO4	Compare various programmable logic devices and its functions
CO5	Enumerate the applications of digital electronics in various fields

TEXT BOOK:

T1 M. Morris Mano, Michel D. Ciletti, *"Digital Design"*, 5th Edition, Pearson Education, New Delhi, 2016.

T2 John.M Yarbrough, "*Digital Logic Applications and Design*", 1st Edition, Thomson Learning, 2017.

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REFERENCES:	
R1	John F.Wakerly, "Digital Design", 4th Edition, PHI Learning Private Limited, New Delhi, 2016.
R2	Thomas L. Floyd, *"Digital Fundamentals"*, 8th Edition, PHI Learning Private Limited, New Delhi, 2015
R3	Charles H.Roth, "Fundamentals of Logic Design", 7th Edition, Thomson Learning, 20153.

Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	3	2	2							2	2	3
CO2	3	3	3	2	2							2	2	3
CO3	3	3	3	2	2							2	2	3
CO4	3	3	3	2	2							2	2	3
CO5	3	3	3	2	2							2	2	3
AVG	3	3	3	2	2	-	-	-	-	-	-	2	2	3

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B.Tech	22MT3251R	MANUFACTURING PROCESS	2	0	2	3

The student should be made

Course Objective

1	To develop the knowledge about the casting and molding process
2	To acquire the fundamentals and various methods of manufacturing process
3	To choose the suitable welding process for manufacturability
4	To identify the different forming operations
5	To identify the finishing and Machining Process

Unit	Description	Instructional Hours
I	**CASTING** Patterns - Cores - Moulding - Green Sand Moulding - Special Casting Process, Shell Mould Casting - Investment Casting - Centrifugal Casting - Casting Defects.	9
II	**MACHINING** Lathe Machine - Lathe Operations - Drilling Machines - Reaming and Tapping Operations - Shaper - Milling Machine. **Experimental Components: Lathe - Facing, Step Turning and Taper Turning**	6+4
III	**WELDING** Arc Welding - Gas Welding - Thermit Welding - Friction Welding - TIG & MIG Welding - Welding Defects. **Experimental Components: Lathe - Grooving, Thread Cutting and Knurling**	6+2
IV	**FORMING** Rolling Operations - Forging Operations - Extrusion and Types - Piercing - Punching - Trimming. **Experimental Components: Drilling, Tapping and Reaming**	6+2
V	**FINISHING OPERATIONS & CASE STUDIES** Grinding - Lapping - Honing - Broaching -Case Study 1: Manufacturing the Agricultural Farm Equipments - Case Study 2: Manufacturing of Aerospace components- Case Study 3: Manufacturing of Robotic Assembly. **Experimental Components: Surface Grinding and Slot Cutting**	6+4
	Total Instructional Hours	**30+15**

Course Outcome

CO1	Choose the suitable casting process based on the product requirements
CO2	Justify the most appropriate manufacturing process and material for a given product
CO3	Interpret the different welding processes used in manufacturing
CO4	Design the process parameters for rolling and sheet metal operations
CO5	Perform a variety of Unconventional Machining Operations on manufacturing products

TEXT BOOK:

T1	Kalpak Jain, "Manufacturing Engineering and Technology", 4th Edition, Addison Wesley Congmen Pvt.Ltd., Singapore,2013.
T2	Jain.R.K, "Production Technology: Manufacturing Processes, Technology and Automation", 17th Edition, Khanna Publishers, New Delhi,2011..

REFERENCES:

R1	Hajra Choudhury, "Elements of Workshop Technology", Vol - I and II, 3rd Edition, Media Promoters and Publishers Pvt. Ltd., Mumbai, 2012
R2	Sharma.P.C, "Production Technology: Manufacturing Processes", 7th Edition, S. Chand and Company Ltd., New Delhi, 2008
R3	Chapman.W.A.J, "Workshop Technology Vol. I and II", 6th Edition, Arnold Publisher, New Delhi, 2006.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	3	3	1	1		1			2	2	2
CO2	3	3	2	3	3	1	1		1			2	2	2
CO3	3	3	2	3	3	1	1		1			2	2	2
CO4	3	3	2	3	3	1	1		1			2	2	2
CO5	3	3	2	3	3	1	1		1			2	2	2
AVG	3	3	2	3	3	1	1	-	1	-	-	2	2	2
1-low, 2-medium, 3-high, '-"- no correlation Note: The average value of this course to be used for program articulation matrix.														

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Programme	Course code	Name of the course	L	T	P	C
B.Tech	22MT3001	INDUSTRIAL MOTOR CONTROL LABORATORY	0	0	4	2

The student should be made

Course Objective

1	To provide hands-on training for starters of electrical motors
2	To impart knowledge on control circuits for jogging and reversing operations
3	To understand solid state devices by conducting experiments
4	To impart knowledge to conduct load test on D.C Machines
5	Exposed to the Load Test on Single and Three Phase Induction Motor

Unit	Description	Instructional Hours
1	Starting and control of motor by DOL Starter method.	3
2	Wire and Test the Control Circuit for Semi-automatic and Automatic Star-Delta Starter	3
3	Wire and Test the Control Circuit for Jogging in Cage Motor and Single-Phase Preventer.	3
4	Study the effect of Forward and Reverse Operations control in cage motors.	3
5	Study of SCR characteristics	3
6	Study of MOSFET characteristics	3
7	Study of IGBT characteristics	3
8	Design and Implementation of Full Wave and Half Wave Rectifier using Diode	3
9	Load Test on D.C. Shunt Motor.	3
10	Load Test on D.C. Series Motor	3
11	Load Test on Single Phase Induction Motor.	3
12	Load Test on Three phase Induction Motor.	3
	Total Instructional Hours	**45**

Course Outcome

CO1	Explain the various types of starters using contactors and relays
CO2	Develop the control circuits for jogging and reversing operations
CO3	Analyse solid state switches
CO4	Validate suitable test to compute the characteristics of DC motors
CO5	Apply the principle and to conduct load test on Induction Motor

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	1	3	1							1	1	2	1
CO2	1	2	3	1							1	1	1	1
CO3	1	2	3	3							1	1	2	1
CO4	2	1	1	1	3						1	1	2	1
CO5	1	1	1	1						3	1	1	1	3
AVG	1.4	1.4	2.2	1.4	0.6	-	-	-	-	0.6	1	1	1.6	1.4
1-low, 2-medium, 3-high, '-"- no correlation Note: The average value of this course to be used for program articulation matrix.														

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Programme	Course code	Name of the course	L	T	P	C
B.Tech	22MT3002	SOLID AND FLUID MECHANICS & MACHINERY LABORATORY	0	0	4	2

	The student should be made	
Course Objective	1	To demonstrate various performance tests on engineering materials
	2	To provide knowledge on deflection test on materials
	3	To impart knowledge of various flow meters and the concept of fluid mechanics
	4	To obtain knowledge on the performance characteristics of pump
	5	To impart knowledge of Kaplan turbine

Unit	Description	Instructional Hours
1	Tension test on a Mild Steel Rod	3
2	Torsion test on a Mild Steel Rod	3
3	Deflection test on Beams	3
4	Compression test on Helical Springs	3
5	Impact test on Mild Steel Rod (Izod)	3
6	Impact test on Mild Steel Rod (charpy)	3
7	Hardness test on Metals by Brinell	3
8	Hardness test on Metals by Rockwell Hardness	3
9	Determination of Coefficient of Discharge by Venturimeter	3
10	Experimental and Verification of Bernoulli's Equation.	3
11	Conducting the experiments and drawing the characteristic curves of Centrifugal Pump	3
12	Conducting the experiments and drawing the characteristic curves of Kaplan Turbine	3
	Total Instructional Hours	**45**

Course Outcome	CO1	Evaluate the different types of mechanical properties of engineering materials
	CO2	Calculate the different stresses and strain of engineering materials
	CO3	Apply the concepts of fluid energy in fluid flow applications
	CO4	Calculate the performance characteristics pump
	CO5	Apply the measurement equipment for flow in turbine

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	2	1	1			1			2		1
CO2	3	2	2	3	1	1			1			2	2	1
CO3	3	2	2	3	1	1			1			2	1	1
CO4	3	2	2	3	1	1			1			2	1	2
CO5	3	2	2	3	1	1			1			2	2	2
AVG	3	2	2	2.8	1	1	-	-	1	-	-	2	1.2	1.4

1-low, 2-medium, 3-high, '-"- no correlation
Note: The average value of this course to be used for program articulation matrix.

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Programme	Course Code	Course Title	L	T	P	C
BE	22HE3071	Soft Skills and Aptitude - II	0	0	0	1

Course Objectives:

1. Solve Logical Reasoning questions of easy to intermediate level
2. Solve Quantitative Aptitude questions of easy to intermediate level
3. Solve Verbal Ability questions of easy to intermediate level
4. Display good writing skills while dealing with essays

Unit	Description	Instructional Hours
I	**Logical Reasoning** Clocks - Calendars - Direction Sense - Cubes - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	9
II	**Quantitative Aptitude** Time and work: Work with different efficiencies, Pipes and cisterns, Work equivalence, Division of wages - Time, Speed and Distance: Basics of time, speed and distance, Relative speed, Problems based on trains, Problems based on boats and streams, - Profit and loss, Basic terminologies in profit and loss - Averages - Weighted average	12
III	**Verbal Ability** Sentence Correction: Subject-Verb Agreement, Modifiers, Parallelism, Pronoun-Antecedent Agreement, Verb Time Sequences, Comparisons, Prepositions, Determiners - Sentence Completion and Para-jumbles: Pro-active thinking, Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues), Fixed jumbles, Anchored jumbles.	7
IV	**Writing skills for placements** Essay writing: Idea generation for topics, Best practices, Practice and feedback	2
	Total Instructional Hours	30

Course Outcome :		
	CO1 :	Students will avoid the various fallacies that can arise through the misuse of logic.
	CO2 :	Students would opt for alternate methods to solve the problems rather than conventional methods.
	CO3 :	Students will heighten their awareness of correct usage of English grammar in writing and speaking
	CO4 :	Students will be concise and clear, using professional language for placements.

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Programme	Course code	Name of the course	L	T	P	C
B.Tech	22MT3901	MINI PROJECT	0	0	4	2

	The student should be made	
Course Objective	1	To acquaint with the process of identifying the needs and converting it into the problem
	2	To familiarize the process of solving the problem in a group.
	3	To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
	4	To inculcate the process of self-learning and research
	5	To prepare the product ideas from the real time problems

Unit	Description	Instructional Hours

Guidelines for Mini Project

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out by all the groups of the students.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project: Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute.
- The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Distribution of Term work marks for both semesters shall be as below;

- Marks awarded by guide/supervisor based on log book : 10
- Marks awarded by review committee : 10
- Quality of Project report : 05

Total Instructional Hours	**45**

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Course Outcome	CO1	Identify problems based on societal /research needs.
	CO2	Apply Knowledge and skill to solve societal problems in a group.
	CO3	Develop interpersonal skills to work as member of a group or leader.
	CO4	Draw the proper inferences from available results through theoretical/ experimental/simulations.
	CO5	Analyse the impact of solutions in societal and environmental context for sustainable development.

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	3	3	3	3	2	3	2	2	2	3
CO2	3	2	2	3	3	3	3	3	2	3	2	2	2	3
CO3	3	2	2	3	3	3	3	3	2	3	2	2	2	3
CO4	3	2	2	3	3	3	3	3	2	3	2	2	2	3
CO5	3	2	2	3	3	3	3	3	2	3	2	2	2	3
AVG	3	2	2	2	2	2	2	2	2	2	2	2	2	3

1-low, 2-medium, 3-high, '-"- no correlation
Note: The average value of this course to be used for program articulation matrix.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22MC3091	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	1	0	0	0

Course Objective	1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understandthe Importance of roots of knowledge system. 2. To make the students understand the traditional knowledge and analyze it and apply it to their day to daylife. 3. To impart basic principles of thought process, Itihas and Dharma Shastra and connecting society andnature. 4. To understand the concept of Intellectual and intellectual property rights with special reference 5. To focus on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and Indian philosophy

Unit	Description	Instructional Hours
	Introduction to traditional knowledge:	
I	Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vs indigenous knowledge, traditional knowledge vs western knowledge	6
	Protection of traditional knowledge:	
II	The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK	6
	Itihas and Dharma-Shastra	
III	**Itihas:** The Mahabharata - The Puranas - The Ramayana **Dharma-Shastra**: Manu Needhi - The Tirukkural – Thiru Arutpa	6
	Traditional knowledge and intellectual property:	
IV	Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge	6
	Indian philosophy	
V	Jain – Buddhist – Charvaka – Samkhya - Yoga - Nyaya - Vaisheshika - Saiva Siddhanta	6
	Total Instructional Hours	30

	On completion of the course the students will be able to
Course Outcome	CO1: Identify the concept of Traditional knowledge and its importance CO2: Explain the need and importance of protecting traditional knowledge. CO3: Explain the need and importance of Itihas and Dharma Shastra. CO4: Interpret the concepts of Intellectual property to protect the traditional knowledge. CO5: Interpret the concepts of indian philosophy to protect the traditional knowledge.

TEXT BOOKS:

T1- Traditional Knowledge System in India, by Amit Jha, 2009.
T2- Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002. T3- "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

REFERENCE BOOKS:

R1- V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5thEdition, 2014.
R2- V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amakuam.

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Department of Mechatronics Engineering

Syllabus Revision carried out in 2024-2025 ODD Semester

2022 Regulation – 2022 Batch V semester- Syllabus revision

S. NO	YEAR	SEM	COURSE CODE& NAME	SUGGESTION BY EXPERTS	EXISTING CONTENT	REVISED CONTENT	TYPE OF REVISION	% OF REVISION
NIL								
						Total Percentage Changes		NIL

New Course Introduced (2022 Regulation) – 2022 Batch V semester

New Course Introduced

S. No	Regulation	Course Code with Name	Credits
1	2022	22MT3901 – Mini Project	2
2	2022	22MT5201 - CNC Technology	3
3	2022	22MT5202 - Control System	4
4	2022	22MT5251 - Embedded System	3

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Department of Mechatronics Engineering

Syllabus Revision carried out in 2024-2025 ODD Semester

5	2022	22MT5001 - CNC laboratory	3
6	2022	22MT5301 - Database Management System	3
7	2022	22MT5302 - Data Science	3
8	2022	22MT5303 - Data Visualization	3
9	2022	22MT5304 - Product Design and Development	3
10	2022	22MT5305 - Advance Manufacturing	3
11	2022	22MT5306 - Material Handling System	3
12	2022	22MT5307 - Principles of Management	3
13	2022	22MT5308 - Disaster Management	3
14	2022	22MT5309 - Supply Chain Management	3
15	2022	22MT5310 - Non-Traditional Machining Techniques	3
16	2022	22MT5311- Computer Integrated Manufacturing	3

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Department of Mechatronics Engineering

Syllabus Revision carried out in 2024-2025 ODD Semester

17	2022	22MT5312 - Flexible Manufacturing System	3
18	2022	22MT5313 - Automobile System	3
19	2022	22MT5314 - Automotive Electronics	3
20	2022	22MT5315 - Electrical Vehicles	3
21	2022	22MT5316 - Mobile Robotics	3
22	2022	22MT5317 - Soft Robotics	3
23	2022	22MT5318 - Micro Robotics	3
24	2019	21MT7601 - PLC and SCADA	3
25	2019	21MT7602 - Industrial Robotics	3
26	2019	21MT7203 - Advanced PLC	3
27	2019	22MT7204 - Distributed Control System	3
28	2019	21MT7205 - Radiological Equipment	3

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Department of Mechatronics Engineering

Syllabus Revision carried out in 2024-2025 ODD Semester

29	2019	21MT7206 - Biomaterials	3
30	2019	21MT7207 - Collaborative Robotics	3
31	2019	21MT7208 - Robot Operating Systems	3

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DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. MECHATRONICS ENGINEERING (UG)

REGULATION-2022

For the students admitted during the academic year 2022-2023 and onwards

SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2	22ME1201	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
THEORY WITH LAB COMPONENT											
3	22HE1151	English for Engineers	HSC	2	0	2	3	4	40	60	100
4	22PH1151	Physics for Non-Circuit Engineering	BSC	2	0	2	3	4	50	50	100
5	22IT1151	Python Programming and practices	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6	22HE1071	Universal Human Values II	AEC	2	0	0	2	2	40	60	100
7	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
8.	22MC1091/ 22MC1092	தமிழரும் தொழில் நுட்பமும் / Indian Constitution	MC	2	0	0	0	2	100	0	100
			TOTAL	**15**	**5**	**6**	**19**	**27**	**470**	**330**	**800**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA2101	Complex Analysis and Differential Equations	BSC	3	1	0	4	4	40	60	100
2	22PH2102	Applied Mechanics	BSC	2	0	0	2	2	40	60	100

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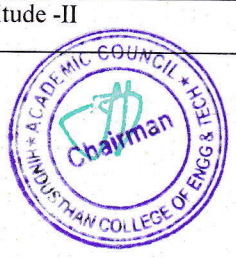
3	**22CY2101**	Environmental Studies	ESC	2	0	0	2	2	40	60	100
THEORY WITH LAB COMPONENT											
4	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
5	**22CY2152**	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
6	**22MT2251**	Fundamentals of Mechatronics	PCC	2	0	2	3	4	50	50	100
PRACTICAL COURSES											
7	**22ME2001**	Engineering Practices	ESC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	**22HE2071**	Design Thinking	AEC	1	0	2	2	3	100	0	100
9	**22HE2072**	Soft Skills -1	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10.	**22MC2091/ 22MC2092**	தமிழர் மரபு / Heritage of Tamils	MC	2	0	0	0	2	100	0	100
11.	**22MC2093**	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							-
			TOTAL	**17**	**1**	**12**	**22**	**30**	**630**	**370**	**1000**

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MA3105**	Fourier Series and Transforms	BSC	3	1	0	4	4	40	60	100
2	**22MT3201**	Industrial Motor Control	ESC	3	0	0	3	3	40	60	100
3	**22MT3202**	Solid and Fluid Mechanics	PCC	3	1	0	4	4	40	60	100
4	**22MT3203**	Digitronics	PCC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
5	**22MT3251**	Manufacturing Process	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
6	**22MT3001**	Industrial Motor Control Lab	ESC	0	0	4	2	4	60	40	100
7	**22MT3002**	Solid and Fluid Mechanics Lab	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	**22HE3071**	Soft Skills and Aptitude -II	SEC	1	0	0	1	1	100	0	100



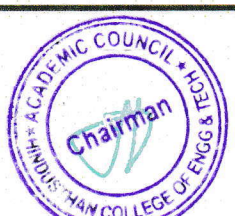
9	22MT3072	Home Automation	AEC	0	0	4	2	4	60	40	100
			TOTAL	**15**	**3**	**14**	**25**	**32**	**490**	**410**	**900**

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22HE4101**	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2	**22MT4201**	Processor and controller	PCC	3	0	0	3	3	40	60	100
3	**22MT4202**	Metrology and Measurements	PCC	3	0	0	3	3	40	60	100
4	**22MT4203**	Theory of Machines	PCC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
5	**22MT4251**	Sensors and Transducers	PCC	2	0	2	3	4	50	50	100
6	**22MT4252**	Fluid Power System	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
7	**22MT4001**	Processor and controller Laboratory	PCC	0	0	4	2	4	60	40	100
8	**22MT4002**	CAD Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	**22HE4071**	Soft Skills and Aptitude -III	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10	**22MC4091**	Indian Constitution	MC	1	0	0	0	1	0	100	100
			TOTAL	**17**	**1**	**12**	**23**	**30**	**480**	**520**	**1000**

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT5201**	CNC Technology	PCC	3	0	0	3	3	40	60	100
2	**22MT5202**	Control System	PCC	3	1	0	4	4	40	60	100
3	**22MT53XX**	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4	**22MT53XX**	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5	**22MT53XX**	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
THEORY WITHLABCOMPONENT											
6	**22MT5251**	Embedded System	PCC	2	0	2	3	4	50	50	100



PRACTICAL											
7	**22MT5001**	CNC laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	**22HE5071**	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**18**	**0**	**6**	**21**	**25**	**410**	**390**	**800**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT6201**	Industrial Automation	PCC	3	0	0	3	3	40	60	100
2	**22HE6101**	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3	**22MT63XX**	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4	**22MT63XX**	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5	**22XX64XX**	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6	**22XX64XX**	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	**22MT6001**	Industrial Automation Laboratory	PCC	0	0	4	2	4	60	40	100
8	**22MT6002**	CAM Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	**22HE6071**	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**20**	**0**	**8**	**24**	**28**	**460**	**440**	**900**

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	**22MT7201**	Virtual Instrumentation	PCC	3	0	0	3	3	40	60	100
2	**22MT7202**	Robotics and Machine Vision	PCC	3	1	0	4	4	40	60	100
3	**22MT73XX**	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
4	**22XX74XX**	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5	**22XX74XX**	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
6	**22MT7001**	Robotics Laboratory	PCC	0	0	4	2	4	60	40	100

EEC COURSES (SE/AE)											
7	22MT7701	Internship*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**15**	**1**	**4**	**20**	**22**	**360**	**340**	**700**

*** - Four weeks internship carries 2 credit and it will be done in before Semester VI summer vacation/placement training and same will be evaluated in Semester VII.**

SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
EEC COURSES (SE/AE)											
1	22MT8901	Project Work/Granted Patent	SEC	0	0	20	10	20	100	0	100
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**0**	**100**

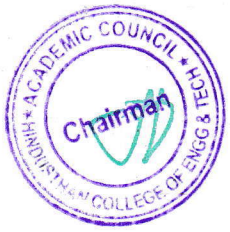
Note:

7. **As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students' who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.**
8. **NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.**
9. **The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2022 – 23.**

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3



OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

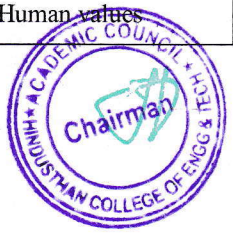
Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22MT7401	Project Management	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3



4	**22LS7404**	Financial independence and management	OEC	3	0	0	3	3
5	**22LS7405**	Yoga for Human Excellence	OEC	3	0	0	3	3
6	**22LS7406**	Democracy and Good Governance	OEC	3	0	0	3	3
7	**22LS7407**	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Diversified Group	**Vertical II Industrial Engineering**	**Vertical III Management Studies**	**Vertical IV Manufacturing Process**	**Vertical V Vehicle Technology**	**Vertical VI Robotics and Automation**
22MT5301 Database Management System	**22MT5304** Product Design and Development	**22MT5307** Principles of Management	**22MT5310** Non-Traditional Machining Techniques	**22MT5313** Automobile System	**22MT5316** Mobile Robotics
22MT5302 Data Science	**22MT5305** Advance Manufacturing	**22MT5308** Disaster Management	**22MT5311** Computer Integrated Manufacturing	**22MT5314** Automotive Electronics	**22MT5317** Soft Robotics
22MT5303 Data Visualization	**22MT5306** Material Handling System	**22MT5309** Supply Chain Management	**22MT5312** Flexible Manufacturing System	**22MT5315** Electrical Vehicles	**22MT5318** Micro Robotics
22MT6301 Cyber Safety	**22MT6303** Non-Destructive Testing	**22MT6305** Economics and Cost Management	**22MT6307** Micro Manufacturing	**22MT6309** Hybrid Vehicles	**22MT6311** Textile Automation
22MT6302 AI for Mechatronics	**22MT6304** Design for Manufacturing and Assembly	**22MT6306** Digital Management	**22MT6308** Industrial 4.0	**22MT6310** Unmanned Aerial Vehicles	**22MT6312** Factory Automation
22MT7301 Optimization Techniques	**22MT7302** Diagnostics Techniques	**22MT7303** Marketing Management	**22MT7304** Rapid Prototyping	**22MT7305** Modern Vehicles Technology	**22MT7306** Automatic System

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Details of Vertical I: Diversified Group

S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
1	**22MT5301**	Database Management System	PEC	3	0	0	3	3
2	**22MT5302**	Data Science	PEC	3	0	0	3	3

3	**22MT5303**	Data Visualization	PEC	3	0	0	3	3
4	**22MT6301**	Cyber Safety	PEC	3	0	0	3	3
5	**22MT6302**	AI for Mechatronics	PEC	3	0	0	3	3
6	**22MT7301**	Optimization Techniques	PEC	3	0	0	3	3

Details of Vertical II: Industrial Engineering

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5304**	Product Design and Development	PEC	3	0	0	3	3
2	**22MT5305**	Material Handling System	PEC	3	0	0	3	3
3	**22MT5306**	Advance Manufacturing	PEC	3	0	0	3	3
4	**22MT6303**	Non-Destructive Testing	PEC	3	0	0	3	3
5	**22MT6304**	Design for Manufacturing and Assembly	PEC	3	0	0	3	3
6	**22MT7302**	Diagnostics Techniques	PEC	3	0	0	3	3

Details of Vertical III: Management Studies

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5307**	Principles of Management	PEC	3	0	0	3	3
2	**22MT5308**	Disaster Management	PEC	3	0	0	3	3
3	**22MT5309**	Supply Chain Management	PEC	3	0	0	3	3
4	**22MT6305**	Economics and Cost Management	PEC	3	0	0	3	3
5	**22MT6306**	Digital Management	PEC	3	0	0	3	3
6	**22MT7303**	Marketing Management	PEC	3	0	0	3	3

Details of Vertical IV: Manufacturing Process

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5310**	Non-Traditional Machining Techniques	PEC	3	0	0	3	3
2	**22MT5311**	Computer Integrated Manufacturing	PEC	3	0	0	3	3
3	**22MT5312**	Flexible Manufacturing System	PEC	3	0	0	3	3

4	**22MT6307**	Micro Manufacturing	PEC	3	0	0	3	3
5	**22MT6308**	Industrial 4.0	PEC	3	0	0	3	3
6	**22MT7304**	Rapid Prototyping	PEC	3	0	0	3	3

Details of Vertical V: Vehicle Technology

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5313**	Automobile System	PEC	3	0	0	3	3
2	**22MT5314**	Automotive Electronics	PEC	3	0	0	3	3
3	**22MT5315**	Electrical Vehicles	PEC	3	0	0	3	3
4	**22MT6309**	Hybrid Vehicles	PEC	3	0	0	3	3
5	**22MT6310**	Unmanned Aerial Vehicles	PEC	3	0	0	3	3
6	**22MT7305**	Modern Vehicles Technology	PEC	3	0	0	3	3

Details of Vertical VI: Robotics and Automation

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5316**	Mobile Robotics	PEC	3	0	0	3	3
2	**22MT5317**	Soft Robotics	PEC	3	0	0	3	3
3	**22MT5318**	Micro Robotics	PEC	3	0	0	3	3
4	**22MT6311**	Textile Automation	PEC	3	0	0	3	3
5	**22MT6312**	Factory Automation	PEC	3	0	0	3	3
6.	**22MT7306**	Automatic System	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE (MECHATRONICS)

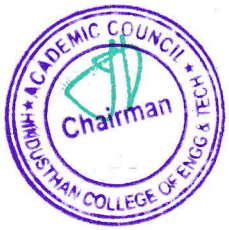
- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.
  Note: Each programme should provide verticals for minor degree

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22MT5601**	Sem 5: Basics of Mechatronics System	MDC	3	0	0	3	3
2	**22MT6601**	Sem 6: Sensors and Interfacing	MDC	3	0	0	3	3
3	**22MT6602**	Sem6: Hydraulics and Pneumatics	MDC	3	0	0	3	3
4	**22MT7601**	Sem 7: PLC and SCADA	MDC	3	0	0	3	3
5	**22MT7602**	Sem 7: Robotics and its Applications	MDC	3	0	0	3	3
6	**22MT8601**	Sem 8: Design of Mechatronics System	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I **Fintech and Block Chain**	**Vertical II** **Entrepreneurship**	**Vertical III** **Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Sustainable infrastructure Development
Fundamentals of Investment	Introduction to Business Venture	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Team Building & Leadership Management for Business	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Creativity & Innovation in Entrepreneurship	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Principles of Marketing Management for Business	Green Technology
Introduction to Fintech	Human Resource Management for Entrepreneurs	Environmental Quality Monitoring and Analysis
	Financing New Business Ventures	



VERTICALS FOR HONOURS DEGREE

Vertical I Industrial Automation	Vertical II Medical Mechatronics	Vertical III Applied Robotics
22MT5203 Concepts of Machines and Mechanisms	22MT5204 Robotics in Medicine	22MT5205 Robots and Systems in Smart Manufacturing
22MT6202 Drives and Actuators for Automation	22MT6204 Brain Computer Interface and its Applications	22MT6206 Medical Robotics
22MT6203 Power Electronics	22MT6205 Digital Image Processing	22MT6207 Agricultural Robotics and Automation
22MT7203 Advanced PLC	22MT7205 Radiological Equipment	22MT7207 Collaborative Robotics
22MT7204 Distributed Control System	22MT7206 Biomaterials	22MT7208 Robot Operating Systems
22MT8201 HMI & SCADA	22MT8202 Bionics	22MT8203 Humanoid Robotics

B.E (Hons) Mechatronics Engineering Specialization in Industrial Automation

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1	22MT5203	Sem 5: Concepts of Machines and Mechanisms	PC	3	0	0	3	3	40	60	100
2	22MT6202	Sem 6: Drives and Actuators for Automation	PC	3	0	0	3	3	40	60	100
3	22MT6203	Sem 6: Power Electronics	PC	3	0	0	3	3	40	60	100
4	22MT7203	Sem 7: Advanced PLC	PC	3	0	0	3	3	40	60	100
5	22MT7204	Sem 7: Distributed Control System	PC	3	0	0	3	3	40	60	100
6	22MT8201	Sem 8: HMI & SCADA	PC	3	0	0	3	3	40	60	100

B.E. (Hons) Mechatronics Engineering Specialization in Medical Mechatronics

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22MT5204	Sem 5: Robotics in Medicine	PC	3	0	0	3	3	40	60	100

2.	22MT6204	Sem 6: Brain Computer Interface and its Applications	PC	3	0	0	3	3	40	60	100
3.	22MT6205	Sem 6: Digital Image Processing	PC	3	0	0	3	3	40	60	100
4.	22MT7205	Sem 7: Radiological Equipments	PC	3	0	0	3	3	40	60	100
5.	22MT7206	Sem 7: Biomaterials	PC	3	0	0	3	3	40	60	100
6.	22MT8202	Sem 8: Bionics	PC	3	0	0	3	3	40	60	100

B.E (Hons) Mechatronics Engineering with Specialization in Applied Robotics

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22MT5205	Sem 5: Robots and Systems in Smart Manufacturing	PC	3	0	0	3	3	40	60	100
2.	22MT6206	Sem 6: Medical Robotics	PC	3	0	0	3	3	40	60	100
3.	22MT6207	Sem 6: Agricultural Robotics and Automation	PC	3	0	0	3	3	40	60	100
4.	22MT7207	Sem 7: Collaborative Robotics	PC	3	0	0	3	3	40	60	100
5.	22MT7208	Sem 7: Robot Operating Systems	PC	3	0	0	3	3	40	60	100
6.	22MT8203	Sem 8: Humanoid Robotics	PC	3	0	0	3	3	40	60	100

Note: Each programme should provide verticals for Honours degree

SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	-	-	-	-	-	20
3	ESC	6	4	5	-	-	-	-	-	15
4	PCC	-	3	13	20	12	7	9	-	64
5	PEC	-	-	-	-	9	9	-	-	18
6	OEC	-	-	-	-	-	3	9	-	12
7	EEC	3	3	3	1	1	2	2	10	25
8	MCC		✓	✓	✓					
Total		19	22	25	23	22	24	20	10	165

CREDIT DISTRIBUTION R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	23	22	24	20	10	165

Chairman BoS

Chairman - BoS
MCT - HiCET

Dean Academics

Dean (Academics)
HiCET

Principal

PRINCIPAL
Hindusthan College Of Engineering & Technolog
COIMBATORE - 641 032.

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5201**	**CNC TECHNOLOGY**	**3**	**0**	**0**	**3**
Course Objective	1. To understand evolution and principle of CNC machine tools 2. To understand the structure and parts of CNC machine tools 3. To describe constructional features of CNC machine tools, drives and positional transducers 4. To generate CNC programs for popular CNC controllers 5. To describe tooling and work holding devices for CNC machine tools					

Unit	**Description**	**Instructional Hours**
	INTRODUCTION TO CNC MACHINE TOOLS	
I	Evolution of CNC Technology, Principles, Features, Advantages, Applications - CNC and DNC Concept -Types of Control Systems - CNC Controllers, Characteristics, Interpolators - Types of CNC Machines - Turning Centre, Machining Centre, Grinding Machine - EDM - Computer Aided Inspection	9
	STRUCTURE OF CNC MACHINE TOOL	
II	CNC Machine Building, Structural Details, Configuration and Design - Guide ways, Friction, Anti friction and other types of Guide ways - Elements used to convert the Rotary motion to a Linear motion - Screw and Nut, Recirculating Ball Screw, Planetary Roller Screw, Recirculating Roller Screw - Rack and Pinion - Spindle Assembly - Torque Transmission Elements - Gears, Timing Belts, Flexible Couplings, Bearings.	9
	DRIVES AND CONTROLS	
III	Spindle Drives - DC Motors - Feed Drives -Stepper Motor - Servo Principle, DC and AC Servomotors - Linear Motors Open Loop and Closed Loop Control - Axis Measuring System - Synchro, Synchro-resolver - Gratings, Moiré Fringe Gratings - Encoders - Inductosysn - Laser Interferometer.	9
	CNC PROGRAMMING	
IV	Coordinate System - Structure of a Part Program - G & M Codes - Tool Length Compensation, Cutter Radius and Tool Nose Radius Compensation - Do Loops, Subroutines, Canned Cycles - Mirror Image - Parametric Programming - Machining Cycles - Programming for Machining Centre and Turning Centre for well known Controllers such as Fanuc, Heidenhain, Sinumerik etc.	9
	TOOLING AND WORK HOLDING DEVICES	
V	Introduction to Cutting Tool Materials - Carbides, Ceramics, CBN, PCD- Inserts Classification - Qualified, Semi Qualified and Preset Tooling - Tooling System for Machining Centre and Turning Centre - Tool for Complete Machining System - Work Holding Devices for Rotating and Fixed Work Parts - Economics of CNC - Maintenance of CNC Machines	9
	Total Instructional Hours	45
	On completion of the course the students will be able to	
Course Outcome	CO1:Gain knowledge on CNC components and their working CO2:Interpret the CNC machine structures and tools CO3:Describe the drives and controls of CNC machines CO4:Program for various CNC operations using part programming techniques CO5:Illustrate the control systems of CNC drives and devices	

TEXT BOOKS:

T1- Graham T Smith, "*CNC Machining Technology*" Springler Verlag, 2016.

T2- Rao P.N., "*CAD/CAM Principles and Applications*", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.

Chairman - BoS
MCT - HiCET

ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

REFERENCE BOOKS:

R1-Evans K., "*Programming of CNC Machines*", 4th Edition – Industrial Press Inc, New York, 2016 R2-Mike Mattson, "*CNC Programming Principles and Applications*", Delmar Cengage learning, 2010.R3- Michael Fitzpatric, "Machining & CNC technology", 3rd Edition, 2013.
R4- Suk.Hwan Suh, "Theory and Design of CNC Systems", Springer, 2008.

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	2	1	1						2	2	2
CO2	3	2	2	2	1	1						2	2	2
CO3	3	2	2	2	1	1						2	2	2
CO4	3	2	2	2	1	1						2	2	2
CO5	3	2	2	2	1	1						2	2	2
AVG	3	2	2	2	1	1	-	-	-	-	-	2	2	2

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22MT5202	Control System	3	1	0	4

Course Objective	1. To solve the fundamental concepts of control systems and mathematical modeling of the system 2. To discuss the concept of time response of the system and error 3. To sketch the plot for frequency response of system and stability analysis 4. To sketch the plot for time response of system and stability analysis 5. To select the controller for mechatronics applications

Unit	Description	Instructional Hours
	SYSTEM REPRESENTATION AND MODELLING	
I	Introduction and Need for Control Systems with Examples-Open Loop and Closed Loop Systems-Transfer Function Model Mathematical Modeling of Mechanical, Electrical Systems –Block Diagram Reduction-Signal Flow Graph.	12
	TIME RESPONSE ANALYSIS	
II	Standard Test Signals - Time Response – First order and Second order systems- Time Domain Specifications- Error Coefficients – Generalized Error series – Steady State Error.	12
	FREQUENCY RESPONSE ANALYSIS	
III	Bode Plot - Polar Plot –Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation	12
	CONCEPT OF STABILITY ANALYSIS	
IV	Concept of stability-Bounded – Input Bounded – Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion	12
	BASIC CONTROLLERS	
V	P, PI, PD and PID Controller–Feed Forward Control-Tuning of Controller–Ziegler Nichols Tuning - Distributed Control System - Case study: Controller design for flow control process.	12
	Total Instructional Hours	60

On completion of the course the students will be able to

Course Outcome	CO1: Interpret different physical, mechanical, electrical system to Construct equivalent models and its Transfer functions. CO2: Describe the response of different order systems for and error series CO3:Analyze the concept of frequency response of system using different plots CO4: Apply the concept of time response of system in stability analysis. CO5: Identify the suitable controller for mechatronics applications.

TEXT BOOKS:

T1- Katsuhik o Ogata, "Modern Control Engineering",5th Edition, PHI Learning Private Limited, New Delhi, 2010.

T2- A. Nagoorkani, *"Control systems Engineering"*, 3rdEdition,RBA Publications,Chennai,2017.

REFERENCE BOOKS:

R1- CurtisD.Johnson, *"Process Control Instrumentation Technology"*, 8th Edition, PHI Learning Private Limited, NewDelhi, 2014.

R2- M Gopal,"Control Systems-Principles and Design", 4thEdition,McGraw Hill Education, NewDelhi,2012.

R3- NormanS.Nise,"Control Systems Engineering",6thEdition, JohnWiley & SonsInc.,NewYork,2010.

R4- S.K.Bhattacharya,*"Control System Engineering"*, 3rd Edition,Pearson,2013.

WEB REFERENCES:

1. http://instrumentationtools.com/difference-between-dcs-plc-systems

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	1								1	1	1
CO2	2	2	3	1								1	1	2
CO3	2	2	2	1	1							1	1	2
CO4	2	2	2	1	1							1	1	2
CO5	2	2	1	1	1							1	1	1
AVG	2	2	2	1	0.6	-	-	-	-	-	-	1	1	1.6
• 1-low, 2-medium, 3-high, '-"- no correlation • Note: The average value of this course to be used for program articulation matrix.														

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22MT5251	Embedded System	2	0	2	3

Course Objective	1. To impart a detailed knowledge of embedded system 2. To visualize the arm processor of architecture 3. To familiarize with the communication networks and devices 4. To illustrate knowledge in real time operating systems 5. To familiarize with the applications of embedded systems

Unit	Description	Instructional Hours
I	**FUNCTIONAL BLOCK OF EMBEDDED SYSTEMS** Definition and Classification - Processor Embedded into a System - Embedded Hardware Units and Devices in a System - Software Tools for Designing Embedded System - Embedded System Design, Architecture & Model	6
II	**AVR and ARM Microcontroller** ATMEL AVR Microcontroller – ARM Microcontroller – Computer System Buses- Real World Interfacing – Buses – I/O Buses– Multilevel Buses	6
III	**DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK** IO Types –Serial Communication Devices - Timer and Counting Devices - Wireless Devices– Serial Bus Communication Protocols- Parallel Bus Device Protocols-	6
IV	**REAL TIME OPERATING SYSTEMS (RTOS) -I** Tasks, task States and Task Thread – Clear Cut Distinction between function, ISR, IST and Task by their Characteristics – Process Management – Memory Management – Interrupt Routine handling in RTOS	6
V	**Case Studies** Case Study of Coding for an Automatic Chocolate Vending machine, Adaptive Cruise Control in Car, Orchestra Playing Robot, RTOS for Control Systems	6
	Instructional Hours	30

1.	Study of ARM Cortex M0,M1, M3,M4	3
2.	LED interfacing with ARM Cortex-M3	3
3.	Stepper Motor interfacing with ARM Cortex-M3	3
4.	LCD interfacing with ARM Cortex-M3	3
5.	UART interfacing with ARM Cortex-M3	3
	Instructional Hours	15
	Total Instructional Hours (Theory + Practical)	45

Course Outcome	On completion of the course the students will be able to CO1: Design the embedded system using software tools CO2: Apply Arm processor in various industries CO3: Discriminate between various protocols like serial and parallel networks CO4: Design an embedded system using real time operating system CO5: Implement to provide an interface between hardware peripherals, sensors and systems

TEXT BOOKS:

T1- P.Rajkamal, *"Embedded System-Architecture, Programming and Design"*, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2015.

T2- Daniel W.Lewis, *"Fundamentals of Embedded Software: with Arm Cortex-M3"*, 2nd Edition, PHI Learning Private Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Frank Vayid, Tony Givargis, *"Embedded System Design- A Unified Hardware & Software Introduction"*,3rd Edition, Wiley India Pvt Ltd., 2009.

R2- Heath Steve *"Embedded Systems Designs"*, 2nd Edition, Newnes, 2003.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	1	3	3	2				2			2	2	2
CO2	3	1	2	1	2							2	2	1
CO3	2	1	1	2								2	1	1
CO4	1	1	2	2		2			2		2	3	2	1
CO5	2	3	2	2									2	2
AVG	2.2	1.4	2	2	0.8	0.4	-	-	0.8	-	0.4	1.8	1.8	1.4
1-low, 2-medium, 3-high, '-"- no correlation Note: The average value of this course to be used for program articulation matrix.														

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		LABORATORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5001**	**CNC LABORATORY**	**0**	**0**	**4**	**2**
Course Objective	1. To study the features and applications of CNC machine tools 2. To impart knowledge in developing program for CNC operations 3. To train the students in manual and computer assisted part programming 4. To impart knowledge in tool path generation and control operation 5. To describe operation of CNC controlled machines tools					
Unit		**Description of the Experiments**			**Practical Hours**	
1	Manual part programming using G and M codes for Turning Operation				3	
2	Manual part programming using G and M codes for Step Turning Operation				3	
3	Manual part programming using G and M codes for Taper Turning Operation				3	
4	Manual part programming using G and M codes for Thread Cutting Operation				3	
5	Manual part programming using G and M codes for Radius Turning on Cylindrical Components				3	
6	Programming and Simulation of machining using Linear Interpolation				6	
7	Programming and Simulation of machining using Circular Interpolation				6	
8	Programming and Simulation of machining using Pocket Milling				3	
9	Programming and Simulation of machining using Slotting				3	
10	Programming and Simulation of machining using Peck Drilling				3	
11	Programming and Simulation of machining using Canned Cycles				3	
12	Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine				6	
		Total Practical Hours			45	
	On completion of the course the students will be able to					
Course Outcome	CO1: Ability to write manual part programming using G and M code for simple component CO2: Develop knowledge on machining operation using CNC machines CO3:Enrich the knowledge and manual and computer assisted part programming CO4: Generate CNC codes for the given model and simulate it CO5: Demonstrate CNC part programming and perform machining operations					

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	2	2	2	2	2	2	2	2	2	1	1
CO2	3	1	2	1	-	-	-	-	-	-	-	-	2	2
CO3	-	3	3	2	-	-	-	-	1	-	-	-	3	3
CO4	-	1	1	-	-	-	-	-	-	-	-	-	1	1
CO5	2	2	2	2	-	-	-	-	-	-	-	1	2	2
AVG	2.3	1.8	2	1.75	2	2	2	2	1.5	2	2	1.5	1.8	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE5072	Soft Skills - IV	0	0	0	1

Course Objectives:	1. To employ soft skills to enhance employability and ensure workplace and career success. 2. To interpret things objectively, to be able to perceive and interpret trends to make generalizations and be able to analyze assumptions behind an argument/statement.

Unit	Description	Instructional Hours
I	**Introduction to Soft Skills:** Introduction- Objective -Hard vs Soft Skills - Measuring Soft Skills- Structure of the Soft Skills -Self management-Critical thinking-Reflective thinking and writing- p2p Interaction	10
II	**Art of Communication:** Verbal Communication - Effective Communication - Active listening –Paraphrasing - Feedback - Non Verbal Communication – Roles-Types-How nonverbal communication can go wrong- How to Improve non verbal Communication - Importance of feelings in communication - dealing with feelings in communication.	10
III	**World of Teams:** Self Enhancement - importance of developing assertive skills-developing self confidence – developing emotional intelligence - Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved - Working with Groups – Dealing with People- Group Decision Making.	10
	Total Instruction Hours	30

Course Outcome:	CO1:	Students will have clarity on their career exploration process and to match their skills and interests with a chosen career path.
	CO2:	Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others
	CO3:	Students will understand how teamwork can support leadership skills

REFERENCE BOOKS:

R1:	Soft Skills Training: A Workbook to Develop Skills for Employment - Frederick H. Wentz
R2:	Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young Talent – by Bruce Tulgan
R3:	Soft Skills Training: A Workbook to Develop Skills for Employment – by Frederick H. Wentz

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		THEORYCOURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5301**	**Data Base Management System**	**3**	**0**	**0**	**3**
Course Objective	1. To learn the fundamentals of data models, relational algebra and SQL 2. To represent a database system using ER diagrams and to learn normalization techniques 3. To understand the fundamental concepts of transaction, concurrency and recovery processing 4. To understand the internal storage structures using different file and indexing techniques which will help in physical DB design 5. To have an introductory knowledge about the Distributed databases, NOSQL and database security					

Unit	**Description**	**Instructional Hours**
	RELATIONAL DATABASES	
I	Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.	9
	DATABASE DESIGN	
II	Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form	9
	TRANSACTIONS	
III	Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm	9
	IMPLEMENTATION TECHNIQUES	
IV	RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for Selection, Sorting and join operations – Query optimization using Heuristics - Cost Estimation.	9
	ADVANCED TOPICS	
V	Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. Database Security: Security issues – Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges	9
	Total Instructional Hours	45

Course Outcome	On completion of the course the students will be able to CO1: Construct SQL Queries using relational algebra CO2:Design database using ER model and normalize the database CO3:Construct queries to handle transaction processing and maintain consistency of the database CO4:Compare and contrast various indexing strategies and apply the knowledge to tune the performance of the database CO5:Appraise how advanced databases differ from Relational Databases and find a suitable database for the given requirement.

TEXTBOOKS:

T1-Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020.

T2- Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017

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R1- C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

WEBREFERENCES:

1. https://dl.acm.org/doi/book/10.5555/556863
2. https://www.grafiati.com/en/literature-selections/database-management/

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	3	2	1	-	-	-	2	1	1	1		
CO2	3	1	1	1	1	-	-	-	2	3	3	3		
CO3	3	2	3	2	1	-	-	-	2	1	1	2		
CO4	1	2	3	2	-	-	-	-	3	2	3	3		
CO5	1	1	3	3	2	-	-	-	1	3	3	1		
AVG	2	2	3	2	1	-	-	-	2	2	2	2		

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5302**	**Data Science**	**3**	**0**	**0**	**3**
Course Objective	1. To understand the data science fundamentals and process. 2. To learn to describe the data for the data science process. 3. To learn to describe the relationship between data. 4. To utilize the Python libraries for Data Wrangling. 5. To present and interpret data using visualization libraries in Python					

Unit	**Description**	**Instructional Hours**
	INTRODUCTION	
I	Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data	9
	DESCRIBING DATA	
II	Types of Data - Types of Variables -Describing Data with Tables and Graphs – Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores	9
	DESCRIBING RELATIONSHIPS	
III	Correlation –Scatter plots –correlation coefficient for quantitative data – computational formula for correlation coefficient – Regression –regression line – least squares regression line – Standard error of estimate – interpretation of r2 – multiple regression equations –regression towards the mean	9
	PYTHON LIBRARIES FOR DATA WRANGLING	
IV	Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables	9
	DATA VISUALIZATION	
V	Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.	9
	Total Instructional Hours	45

Course Outcome	On completion of the course the students will be able to CO1: Define the data science process CO2: Understand different types of data description for data science process CO3: Gain knowledge on relationships between data CO4: Use the Python Libraries for Data Wrangling CO5: Apply visualization Libraries in Python to interpret and explore data

TEXT BOOKS:

T1- David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)

T2- Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017

T3- Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

REFERENCE BOOKS:

R1- Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press,2014

WEB REFERENCES:

1. https://www.coursera.org/in/articles/what-is-data-scien
2. https://www.datasciencecentral.com/

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	1	2	2	-	-	-	1	1	1	2	2	2
CO2	2	1	-	1	1	-	-	-	2	1	1	2	2	3
CO3	2	2	1	2	2	1	1	-	1	2	1	3	2	2
CO4	3	2	2	1	2	-	-	-	1	1	2	2	3	3
CO5	2	2	1	2	2	-	-	-	1	1	1	2	2	2
AVG	2	2	1	2	2	1	1	-	1	1	1	2	2	2
• 1-low, 2-medium, 3-high, '-"- no correlation • Note: The average value of this course to be used for program articulation matrix.														

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5303**	**Data Visualization**	**3**	**0**	**0**	**3**
Course Objective	1. To gain skill in designing real time interactive information visualization system. 2. To understand the fundamentals of data visualization 3. To know the working principles of various information visualization depth tools. 4. To acquire knowledge about the issues in data representation 5. To visualize the Data using tools Tableau					

Unit	**Description**	**Instructional Hours**
	INTRODUCTION	
I	Context of data visualization – Definition, Methodology, Visualization design objectives .Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools. Mapping - Time Series - Connections and Correlations –Scatter plot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs.	9
	VISUALIZATION TECHNIQUES FOR TIME-SERIES, TREES & GRAPHS	
II	Mapping - Time series - Connections and correlations – Indicator-Area chart-Pivot table-Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods-Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Info graphics	9
	TEXT AND DOCUMENT VISUALIZATION	
III	Acquiring data, -Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder,Asynchronous Image Downloads, Web Techniques, Parsing data -Levels of Effort, Tools for Gathering Clues, Text Markup Languages, Regular Expressions, Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.	9
	INTERACTIVE DATA VISUALIZATION	
IV	Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geo mapping – Exporting, Framework – D3.js, Tableau Dashboards	9
	SECURITY IN DATA VISUALIZATION	
V	Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating secured visualization system..	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Apply mathematics and basic science knowledge for designing information visualizing System. CO2: Collect data ethically and solve engineering problem in visualizing the information. CO3: Implement algorithms and techniques for interactive information visualization. CO4:Conduct experiments by applying various modern visualization tool and solve the space layout problem. CO5: Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams.Develop a cost effective and a scalable information visualization system.

TEXT BOOKS:

T1- Robert Spence, "Information Visualization An Introduction", Third Edition, Pearson Education, 2014.
T2-Colin Ware, "Information Visualization Perception for Design", Third edition, Margon Kaufmann Publishers, 2012.
T3- Matthew O. Ward, George Grinstein, Daniel Keim, "Interactive Data Visualization: Foundation, Techniques and Applications", Second Edition, A. K. Peters/CRC Press, 2015

REFERENCE BOOKS:

R1- Benjamin B. Bederson and Ben shneiderman, "The Craft of Information Visualization", Morgan Kaufmann Publishers, 2003.
R2- Thomas strothotte, "Computational Visualization: Graphics, Abstraction andInteractivity", Springer, 1998

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1. https://gold.rl.talis.com/lists/F154655D-9ACC-EFE7-4092-EAD618A9BCAB/bibliography.html?style=springer-lecture-notes-in-computer-science

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2. https://www.techtarget.com/searchbusinessanalytics/definition/data-visualization

Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	1	3	-	3	-	1	-	-	-	-	2	2	2
CO2	3	-	3	2	3	-	1	-	-	-	-	-	2	3
CO3	3	2	3	-	3	-	-	-	-	-	-	1	2	2
CO4	2	2	-	2	3	-	1	-	-	-	-	2	1	2
CO5	3	2	2	2	-	-	1	-	-	-	-	2	-	3
AVG	3	2	3	-	3	-	-	-	-	-	-	2	2	2.4

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5304**	**Product Design and Development**	**3**	**0**	**0**	**3**

Course Objective	1. To learn several aspects of the Product Design Process 2. To select suitable methodology for Product Development 3. To familiarize about the concept of Product Architecture 4. To provide knowledge about the concept of manufacturing in Product Design 5. To impart knowledge about Design of Manufacturing

Unit	Description	Instructional Hours
	PRODUCT DESIGN	
I	Introduction - Product Life Cycles - Characteristics of Successful Product Development - Design and Development of Product s -Types of Design and Re Designs - Engineering Designs - Duration and Cost of Product Development -Challenges of Product development.	9
	CONCEPT GENERATION AND SELECTION	
II	Task - Structured Approaches - Clarification - Search - Externally and Internally -Explore Systematically - Reflect on the Solutions and Processes - Concept Selection - Methodology - Benefits.	9
	PRODUCT ARCHITECTURE	
III	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.	9
	INDUSTRIAL DESIGN	
IV	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 Product s - User - Driven Product s - Assessing the Quality of Industrial Design.	9
	DESIGN FOR MANUFACTURING	
V	Definition - Overview of DFM Process Estimation of Manufacturing Cost - Reducing the Component Costs and Assembly Costs - Estimating the Manufacturing Cost -Reduce the Costs of Component and Assembly- Impact of DFM Decision on Other Factors.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Design the Product s for the given set of applications CO2: Generate and select suitable Design methods to Design the Product CO3: Design a Product , component or process to meet desired needs CO4: Use CAE, CAD and CAM in industrial Product Design CO5: Design the Product s for manufacturing and Assembly

TEXT BOOKS:

T1- Karl T. Ulrich and Stephen D. Eppinger, "Product Design and Development", 7 th Edition, Tata McGraw Hill Publishing Company Limited, NewDelhi, 2020.

T2- S. Dalela and Mansoor Ali, Industrial Engineering and Management Systems, Standard Publishers Distributors Pvt. Ltd.,New Delhi, 2006.

REFERENCE BOOKS:

R1- Kevin Otto, Kristin wood, "Product Design", 4 th Edition, Pearson Education, Australia, 2012.

R2- Harry Nystrom, Creativity and Innovation, John Wiley and Sons Pvt. Ltd., 1 st Edition Singapore, 1988.

R3- Benjamin W. Niebel and Alanb.Draper, "Product Design and Process Engineering", 1 st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1976.

R4- Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, 1992, ISBN 1-55623-603-4.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	1	3	-	3	-	1	-	-	-	-	2	2	2
CO2	3	-	3	2	3	-	1	-	-	-	-	-	2	3
CO3	3	2	3	-	3	-	-	-	-	-	-	1	2	2
CO4	2	2	-	2	3	-	1	-	-	-	-	2	1	2
CO5	3	2	2	2	-	-	1	-	-	-	-	2	-	3
AVG	3	2	3	-	3	-	-	-	-	-	-	2	2	2.4

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5305**	**Advance Manufacturing**	**3**	**0**	**0**	**3**
Course Objective	1. The objective of this course is to teach the lean tools to attain optimum level in quality. 2. To enhance the ability to make decisions for new product development. 3. Aims to develop the students to conserve energy and natural resources, and to ensure that they have minimal impact on the environment and society. 4. To give students an introduction to an advanced information process technique. 5. To learn about the various smart manufacturing techniques and applications.					

Unit		Description		Instructional Hours	
	INTRODUCTION TO LEAN MANUFACTURING				
I	Objectives of lean manufacturing-key principles and implications of lean manufacturing - traditional Vs lean manufacturing- flow-continuous improvement/Kaizen –worker involvement5S principles elements of JIT - uniform production rate - Kanban system – Lean implementation, Reconciling lean with other systems - lean six sigma- lean and ERP - lean with ISO 9001:2000.			9	
	AGILE MANUFACTURING				
II	Agile Manufacturing Vs Mass Manufacturing - Agile practice for product development - Manufacturing agile practices - Implementing new technology - A checklist, technology applications that enhance agility - agile technology make or buy decisions. - Costing for Agile Manufacturing practices.			9	
	SUSTAINABLE MANUFACTURING				
III	Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.			9	
	INTELLIGENT MANUFACTURING				
IV	Introduction to intelligent manufacturing- fundamentals of artificial intelligence-AI in manufacturing processes- introduction to fuzzy logic-applications of fuzzy logic in manufacturing- integrating AI and fuzzy logic in production planning-real time decision makingcase studies and practical applications- emerging trends and future directions			9	
	SMART MANUFACTURING				
V	Introduction to various Smart Manufacturing Techniques-Supply chain management-Block chain of inventory management-Plant digitization-Predictive maintenance-Supply chain visibility-Warehouse-Cost reduction-Waste management-Automated systems-Applications			9	
		Total Instructional Hours		45	

	On completion of the course the students will be able to
Course Outcome	CO1: Demonstrate on basic lean manufacturing. CO2: Integrate the knowledge on agile manufacturing. CO3: Formulate strategy in sustainable manufacturing. CO4: Apply artificial intelligence (AI) and fuzzy techniques to improve the efficiency of manufacturing systems. CO5: Exposure to smart manufacturing and its various techniques.

TEXT BOOKS:

T1. Lonnie Wilson, "How to Implement Lean manufacturing", McGraw-Hill Professional; 2nd edition, 2015.
T2 Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042.
T3 Kusiak, Andrew, "Intelligent Manufacturing Systems", Prentice Hall, 1st edition, 1990.

REFERENCE BOOKS:

R1- Black .J.T. and Kohser R.A, "DeGarmo's Materials and Processes in Manufacturing", Published by Wiley, 11th edition, 2011.
R2- Christian N. Madu, "Handbook of environmentally conscious manufacturing", Springer US Publishers, 1st edition, 2001.
R3- John Schey, "Introduction to Manufacturing Processes", Tata McGraw-Hill Education ,3rd edition,1999
R4- Seliger G., "Sustainable Manufacturing: Shaping Global Value Creation", Springer, United States, 2012, ISBN 978-3-642-27289-9.
R5. Rao R. V, "Advanced Modeling and Optimization of Manufacturing Processes", 2nd edition, 2006.
R6. Ronald G. Askin and Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.

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R7. Kutz M., "Environmentally Conscious Mechanical Design", John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4. 55623-603-4.

Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	-	2	-	-	2	2	2	-	1	1	2	2	2
CO2	3	-	-	-	-	2	2	-	-	1	1	2	1	2
CO3	3	-	-	-	-	2	2	3	-	1	1	2	1	2
CO4	2	-	3	-	-	2	2	-	-	1	1	2	2	2
CO5	3	-	3	-	-	2	2	2	-	1	1	2	2	2
AVG	3	-	2.6	-	-	2	2	2.3	-	1	1	2	1.8	2

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5306**	**Material Handling System**	**3**	**0**	**0**	**3**

Course Objective	1. To provide knowledge on materials handling equipment. 2. To enhance the ability to make mechanical handling equipment that moves materials from one location to another. 3. Aims to develop the materials handling system which reducing the amount of time spent moving the products. 4. To improve the construction efficiency and productivity using cranes, hoists and monorails. 5. To learn about the various special materials handling equipment and applications.

Unit	**Description**	**Instructional Hours**
	INTRODUCTION TO MATERIAL HANDLING	
I	Introduction to materials handling, examples of materials equipment classification of materials handling equipment, continuous conveying, intermittent conveying, examples, lifting, hoisting, handling of bulk goods and piece goods, cranes and conveyors, principles of calculation of conveying equipment, cycle time, bulk materials and bulk density, angle of repose, example for a belt conveyor and a simple hoist.	9
	CONVEYING MACHINERY	
II	Belt conveyors, constructional details, toughing angle, idlers, belt specifications, chutes, skirt boards, ploughs, belt conveyor layouts, belt trippers, and typical examples, roller conveyors, overhead conveyors, apron conveyors, component parts and operational details and applications with typical layouts	9
	MATERIALS HANDLING AND STORAGE	
III	Unit load concept (platform sheet industrial hand trucks, self-contained unitload, palletless handling, introduction only), industrial hand trucks, powered industrial trucks, automated guided vehicles, basic storage and equipment system, Automated storage and retrieval systems (AS/ RS), carosel storage system and its applications.	9
	CRANES, HOISTS AND MONORAILS	
IV	Jib cranes, like wall mounted and travelling type, stability criteria, wheel loads, wheel trucks and bogeys, number of mechanisms in jib cranes, jib construction. Harbour cranes, luffing and level luffing cranes, shipyard gantry cranes, portal frames and slewing rings and bearings typical stability calculations of portal cranes, types of hoists.	9
	SPECIAL MATERIALS HANDLING EQUIPMENT	
V	Special materials handling equipment, wagon tipplers, stackers, reclaimers, their constructional details, pneumatic conveyers, typical materials handling layouts and applications.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO 1 Classify the material handling equipment. CO 2 Explain the usage of different material handling equipment in industry CO 3 Discuss how to connect loading stations to the different discharge conditions CO 4 Associate the usage of cranes at industries CO 5 Extend the knowledge for working on special material handling equipment

TEXT BOOKS:

T1 Material handling handbook, 2nd edition, ASME, 1985.

T2 Automation, production systems and computer integrated manufacturing, Mikell P.Groover, Prentice-Hall of India. 2001.

REFERENCE BOOKS:

R1- R.O.Bailey, "Bulk material handling by conveyor belt I&II", M.A. Alspaugh

R2- Bolz, H. A and Hagemann, G. E (ed.), ''Materials Handling Handbook'', Ronald Press. IS 8005:1976, Classification of Unit Loads, Bureau of Indian Standards.

R3- Apple, J.A., ''Material Handling System Design'', John Wiley & Sons Allegri, T.H., ''Materials Handling: Principles and Practice'', CBS Publishers Distributors, N. Delhi.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	-	2	-	-	2	2	2	-	1	1	2	2	2
CO2	3	-	-	-	-	2	2	-	-	1	1	2	1	2
CO3	3	-	-	-	-	2	2	3	-	1	1	2	1	2
CO4	2	-	3	-	-	2	2	-	-	1	1	2	2	2
CO5	3	-	3	-	-	2	2	2	-	1	1	2	2	2
AVG	3	-	2.6	-	-	2	2	2.3	-	1	1	2	1.8	2

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5307**	**Principles of Management**	**3**	**0**	**0**	**3**
Course Objective	1. To impart knowledge about functions of management and manager in an organization 2. To familiarize about planning and management objectives 3. To classify organization structure and its process 4. To recognize various motivational techniques and theories 5. To learn different approaches to management through case studies					

Unit	Description	Instructional Hours
	MANAGEMENT	
I	Definition-Importance-Functions- Skills Required for Managers-Roles and Functions of Managers-Science and Art of Management-Management and Administration -Types of Business Organization - Sole Proprietorship, Partnership, Company-Public and Private Sector Enterprises.	9
	PLANNING	
II	Nature and Purpose-Steps Involved in Planning-Types of Plans –Plans at Individual, Department and Organization Level - Managing by Objectives - Forecasting - Purpose - Steps and Techniques –Decision Making-Steps in Decision Making.	9
	ORGANIZING	
III	Nature and Purpose of Organizing - Formal and Informal Organization – Organization Chart-Structure and Process-Strategies of Departmentation-Line and Staff Authority - Benefits and Limitations-Centralization Vs De-Centralization Staffing-Manpower Planning- Recruitment -Selection-Placement.	9
	DIRECTING AND CONTROLLING	
IV	Theories and Techniques of Motivation - Leadership - Types and Theories of Leadership-System and Process of Controlling-Budgetary and Non-Budgetary Control Techniques-Direct and Preventive control.	9
	APPROACH TO MANAGEMENT AND CASE STUDIES	
V	American Approach to Management-Japanese Approach to Management-Indian Approach to Management - Case Studies: Curtain Dream - Compsoft - Headland – Dragon Data -Wardle Storeys.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1:Apply the function of management in an organization CO2:Develop various planning techniques to apply it in public and private sector enterprises CO3:Solve the problem faced by the workers due to decentralization CO4:Illustrate the leadership qualities and to apply motivational techniques CO5:Enumerate different approaches to management through case studies

TEXT BOOKS:

T1-Harold Koontz & Heinz Weihrich, "Essentials of management",9th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi ,2012.

T2-P.C.Tripathy and P.N.Reddy, "Principles of Management",5th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

REFERENCEBOOKS:

R1- Stephen A.Robbins & David A.Decenzo & Mary Coulter, "*Fundamentals of Management*", 7th Edition, Pearson Education,NewJersey,2011.

R2- JAF Stoner, Freeman R.E and Daniel R Gilbert "*Management*", 6th Edition, Pearson Education, New York, 2004.

R3- StephenP. Robbins & Mary Coulter,"*Management*", 10thEdition,PHI Learning Private Limited, New Delhi,2007.

R4- Robert Kreitner & Mamata Mohapatra,"Management",Biztantra,2008.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO2	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO3	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO4	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO5	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
AVG	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5308**	**Disaster Management**	**3**	**0**	**0**	**3**
Course Objecti ve	1. To provide students an exposure to disasters, their significance and types. 2.To understand the relationship between vulnerability, disasters, disaster prevention and risk reduction3.To explain approaches of psychological impact of disasters 4.To enhance the risk management with respect to India5.To understand the technological disaster					

Unit	**Description**	**Instructional Hours**
	INTRODUCTION TO DISASTERS	
I	Definition: Disaster, Hazard, Vulnerability, Resilience, Risks - Disasters: Types of disasters - Earthquake, Landslide, Flood, Drought, Fire - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disaster.	9
	APPROACHES TO DISASTER RISK REDUCTION (DRR)	
II	Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake – holders- Institutional Process and Framework at State and Central Level- State Disaster Management Authority(SDMA) - Early Warning System - Advisories from Appropriate Agencies.	9
	PSYCHOLOGICAL IMPACT OF DISASTERS	
III	Introduction – Approaches and Diagnostic Issues –Principles of psychosocial Intervention -Special Intervention techniques – Stress Reduction Techniques.	9
	DISASTER RISK MANAGEMENT IN INDIA	
IV	Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation - Role of GIS and Information Technology Components , Risk Assessment, Response and Recovery Phases of Disaster - Disaster Damage Assessment	9
	TECHNOLOGICAL DISASTER AND CASE STUDIES	
V	Technological disaster - Industrial hazards -Fire hazards - Role of remote sensing - Application of GIS Technology- Accidental Disaster, Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Differentiate the types of disasters, causes and their impact on environment and society. CO2: Assess vulnerability and various methods of risk reduction measures as well as mitigation.CO3: Interpret the psychological impact and its reduction techniques. CO4: Express the knowledge disaster management with respect to India CO5: Understand the industrial hazard and its management.

TEXT BOOKS:

T1- Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423

T2- Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367,ISBN-13: 978-1259007361]

T3- Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCE BOOKS:

R1- Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, NewDelhi, 2011R2- Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005

R3- Government of India, National Disaster Management Policy,2009.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO2	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO3	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO4	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO5	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
AVG	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
BE	22MT5309	Supply Chain Management	3	0	0	3

Course Objective		The student should be made
	1	To acquire knowledge on the demand management in supply chain
	2	To apply operation management in supply chain
	3	To develop procurement and logistics management in supply chain
	4	To enhance supply chain management using Information Technology
	5	To apprehend performance measurement and control in SCM

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SCM & DEMAND MANAGEMENT IN SUPPLY CHAIN** SCM: Present Need, Model, Evolution, Approach and its Elements. Types of Demand - Characteristics and Methods of Forecasting. Time series Forecasting Method, Forecast Error. CODP and Marketing Environment suitable for SCM. Industries and their classification- Supply Chain Strategy- CPFR and its implementation. (3 Case studies)	9
II	**OPERATIONS MANAGEMENT IN SUPPLY CHAIN** Basic Principles of Manufacturing Management. Key concepts, Misconception, Misgiving, Elements, Benefits & Integration of Lean Manufacturing with SCM. Stages of Manufacturing. Mass Customisation: Meaning, Myths, Implication, Benefits, Information Cycle, Industry Overview. Outsourcing, Brand Management, Licensing. Service Operation Management-Optimization, Managing Supply and Demand, World Class Service, Growth and Expansion (6 Case studies)	9
III	**PROCUREMENT MANAGEMENT IN SUPPLY CHAIN & LOGISTICS MANAGEMENT** Inventory Management – Inventory Models –Economic Order Quantity – Inventory Counting System with examples. New Paradigms in Inventory and Purchase management-MRP –JIT – Vendor Managed Inventory. (2 Case Studies) Logistics Management: Elements. Distribution: Management, Strategies, Pool. Transportation Management, Service Innovation, Intermodal Transportation, Containerization Ware Housing Automation, WMS, Packing for Logistics, 3PL & 4PL. (8 Case Studies)	9
IV	**INFORMATION TECHNOLOGY FOR SUPPLY CHAIN MANAGEMENT** Concept of IT- IT Application in SCM- APS – Data Mining. Use of Data Mining Tools in SCM. Forecasts. SCM in Electronic Business. Role of Knowledge worker in SCM. (2 Case Studies)	9
V	**PERFORMANCE MEASUREMENT AND CONTROLS IN SUPPLY CHAIN MANAGEMENT** Benchmarking: Introduction, Concepts, Forms. (1 Case Study). SCOR: Modeling, Characteristics, Analysis. Concept of Configurability. Balance Scorecard for SCM. (2 Case Study)	9
	Total Instructional Hours	45

Course Outcome	CO1	Remember the concepts of SCM
	CO2	Understand Operation Management in Supply Chain
	CO3	Apply procurement and logistics usage in SCM
	CO4	Develop IT solutions to SCM
	CO5	Create SCM and measure and evaluate the performance of SCM.

TEXT BOOK:	
T1	Rahul V Altekar, "Supply Chain Management Concepts and Cases", Eastern Economy Edition, PHI Learning Private Limited, 2013
T2	B.S. Sahay, " Supply Chain Management For Global Competitiveness", Second Edition, Macmillan India Ltd, 2004
REFERENCES:	
R1	Sunil Chopra, Peter Meindl, D.V.Kalra, "Supply Chain Management Strategy, Planning, and Operation", Fifth Edition, Pearson, 2016
R2	Joel D.Wisner, G.Keong Leong, Keah-Choon Tan, "Principles of Supply Chain Management : A Balanced Approach"

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3										2	1	2	1
CO2	3										2	1	2	1
CO3	3	2									2	1	2	1
CO4	3		2							1	2	1	2	1
CO5	3		2								2	1	2	1
AVG	3	0.4	0.8							0.2	2.2	1	2	1
1-low, 2-medium, 3-high, '-"- no correlation Note: The average value of this course to be used for program articulation matrix.														

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5310**	**Non-Traditional Machining Techniques**	**3**	**0**	**0**	**3**

Course Objective	1. To select the process parameters of different advanced manufacturing processes 2. To express their knowledge of electrical based manufacturing processes over conventional techniques 3. To list the chemicals used in the manufacturing process 4. To choose the suitable thermal techniques to achieve the high precision on the machining component 5. To examine the surface coating processes

Unit	**Description**	**Instructional Hours**
	MECHANICAL ENERGY BASED PROCESSES	
I	Introduction-Modern Machining Process-Need-Advantages & Applications-Abrasive Jet Machining (AJM)- Working Principles-Process Parameters-Applications - Water Jet Machining (WJT) -Working Principles - Process Parameters –Applications –Ultrasonic Machining(USM)- Working Principles- Process Parameters -Applications.	9
	ELECTRICAL ENERGY BASED PROCESSES	
II	Electric Discharge Machining (EDM)-Working Principles-Equipments-Process Parameters-Material Removal Rate-Tool-Dielectric-Flushing-WireCut EDM and its Applications - Electric Discharge Grinding -Working Principle - Equipment -Process Parameters Applications.	9
	CHEMICAL AND ELECTRO CHEMICAL ENERGY BASEDPROCESSES	
III	Chemical Machining (CHM) - Etchants - Maskant - Techniques of Applying Maskant – Process Parameters- Material Removal Rate-Applications-Electro Chemical Machining(ECM)- Principles of ECM -Equipments- Material Removal Rate- Process Parameters – Electro Chemical Grinding (ECG) and Electro Chemical Honing (ECH)-Applications.	9
	THERMAL ENERGY BASED PROCESSES	
IV	Laser Beam Machining (LBM) - Principles - Equipment -Applications - Plasma Arc Machining (PAM)- Principles-Equipment-Types-Beam Control Techniques- Applications-Electron BeamMachining (EBM)-Principles-Equipment-Types –Beam ControlTechniques-Applications.	9
	SURFACE COATING AND HARDENING PROCESS	
V	Classification - Removal Processes - Conversion Coatings – Thermal Treatments –Metal Coatings-Physical Vapour Deposition (PVD) Chemical Vapour Deposition (CVD) - Ion Plating - Galvanizing -Electroplating - Organic Coatings – Surface hardening- Laser hardening.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1:List the process parameters of different manufacturing process CO2:Operate the advanced electrical machining operation on the given component CO3:Select the appropriate chemical process based on the product material CO4:Interpret how a thermal techniques to be carried out CO5:Analyse and improve manufacturing processes through surface coating

TEXT BOOKS:

T1-Benedict.G.F,"NonTraditionalManufacturing Processes", 2 nd Edition, Taylor, CRCPress,NewYork,2019.
T2- Kaushik kumar, J,Paulo Darim Divya Zindani,"Advanced Machining and Manufacturing Processes", 1 st Edition, Springler Nature,2018.

REFERENCE BOOKS:

R1- V. K. Jain, "Advanced Machining Processes",4 th Edition, Allied Publishers, 2009.
R2- EWeller,"NonTraditionalMachiningProcess",2 nd Edition,2006.
R3- P.C.Pandey, "Modern Machining Process", Mcgraw Hill Education, 2017.
R4- "AdvanceAnalysisofNonTraditionalMachining",Springer,DRC2012.

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1. http://www.sciencedirect.com/science/article/pii/S1877705815004798
2. http://www.slac.stanford.edu/cgi-wrap/getdoc/slac-r-621.pdf

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	3	2	3		1					2	2	2
CO2	3	2	3	2	3		1					2	2	3
CO3	3	2	3	2	3		1					2	2	2
CO4	3	2	3	2	3		1					2	2	2
CO5	3	2	3	2	3		1					2	2	3
AVG	3	2	3	2	3	-	1	-	-	-	-	2	2	2.4

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5311**	**COMPUTER INTEGRATED MANUFACTURING**	**3**	**0**	**0**	**3**

Course Objective	1. Gain knowledge about importance of CIM and use of computers in automated systems. 2. Enhance the fundamental knowledge in production planning and computerized process planning 3. Extend the knowledge about cellular manufacturing 4. Gain knowledge about FMS and in material handling system 5. Acquire fundamental knowledge of industrial robotics and their applications

Unit	**Description**	**Instructional Hours**
	INTRODUCTION	
I	Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control-Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Types of production –Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.	9
	PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING	
II	Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP).	9
	CELLULAR MANUFACTURING	
III	Group Technology(GT), Part Families – Parts Classification and coding – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method – Arranging Machines in a GT cell.	9
	FLEXIBLE MANUFACTURING SYSTEM AND AUTOMATED GUIDED VEHICLE SYSTEM	
IV	Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.	9
	INDUSTRIAL ROBOTICS	
V	Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems– End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability – Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Understand the concept and technology of CIM. CO2: Illustrate the Production planning and material requirements planning. CO3: Understand the history of Group Technology, Compare and select suitable automated material handling system and automated inspection. CO4: Discuss the advanced technology of material handling, flexible manufacturing system and automated guided vehicles. CO5: Develop the use of computers for Robotics in CIM.

TEXT BOOKS:

T1- Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 2015.
T2- Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", PHI Learning Private Limited, New Delhi, 2014.

REFERENCE BOOKS:

R1- James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2015.
R2- Mikell. P. Groover and Emory ZimmersJr. "CAD/CAM", Prentice hall of India Pvt. Ltd., 2018.
R3- Chryssolouris G.,"Manufacturing Systems:Theory and Practice", Second Edition Springer,2016.
R4- Rao. P. N., Tewari. N. and Kundra. T.K., "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2015..

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2				2				1	2	1	1		1
CO2	2	1			3					2		1		2
CO3	2	1	1		2					2				2
CO4	2				3					2				3
CO5	2	1	1		1					2		1		1
AVG	2	0.6	0.4	-	2	-	-	-	0.2	2	0.2	0.6	-	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5312**	**Flexible Manufacturing System**	**3**	**0**	**0**	**3**

Course Objective	1. To understand basic concepts of flexible manufacturing systems 2. To classify material handling system and AGVs 3. To study various storage methods and its equipment 4. To learn about the automated systems in different manufacturing. 5. To list out different assembly methods in industries		
Unit	**Description**	**Instructional Hours**	
	INTRODUCTION		
I	Overview of manufacturing operations – Manufacturing operations – Basic Elements of an Automated Systems- Advanced Automation Functions- Levels of Automation- Industrial Robotics – Anatomy and related attributes- Robot control Systems- End effectors- CNC-Fundamentals of NC technology.	9	
	MATERIAL TRANSPORT SYSTEM		
II	Introduction - Material Handling equipment - Design considerations in Material Handling - Industrial trucks - Automated guided vehicles - Monorails and other Rail Guided Vehicles - Conveyors - Cranes and Hoists - Analysis of Vehicle Based System - Conveyor Analysis	9	
	STORAGE SYSTEM		
III	Introduction - Performance - Strategies - Conventional Storage Methods and Equipment - Automated Storage System - Carousel Storage System - Engineering Analysis of Storage System.	9	
	MANUFACTURING SYSTEMS		
IV	Components of Manufacturing System - Single Station Manufacturing Cells, Manual Assembly Lines - Automated Production Lines - Automated Assembly Systems.	9	
	ASSEMBLY SYSTEMS		
V	Robotic Assembly Automation - Parts Presentation Methods - Assembly Operations – Compliance and Remote Centre Compliance (RCC) Device - Adaptable Programmable Assembly System	9	
	Total Instructional Hours	45	
	On completion of the course the students will be able to		
Course Outcome	CO1:Apply the flexible manufacturing concept in manufacturing sector CO2: Develop different material handing mechanisms for industries CO3: Propose the benefits of automated storage systems CO4:Compare manual assembly lines and automated assembly lines CO5: Observe and analyze different assembly operations in industries		

TEXT BOOKS:

T1- Groover, M.P. "Automation, Production Systems, and Computer - Integrated Manufacturing", 4 th Edition,Pearson Education, 2008.
T2 -C.Ray Asfahl, "Robotics and Manufacturing automation", 2nd Edition, John Wiley and Sons Ltd., NewDelhi, 2011.
T3- Groover, M.P., "Fundamentals of Modern Manufacturing", Pearson Education, New Delhi, 2004

REFERENCE BOOKS:

R1 Groover, M.P. and Simmers, E.W. "Computer Aided Design and Manufacturing", Pearson Education, New Delhi,2009.
R2 Nand K. Jha. "Handbook of Flexible Manufacturing Systems", Academic Press, Orlando, 2006.
R3 Daniel E Kandray P E, "Programmable Automation", Industrial Press Publications, New Delhi, 2008.2015..

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2				2				1	2	1	1		1
CO2	2	1			3					2		1		2
CO3	2	1	1		2					2				2
CO4	2				3					2				3
CO5	2	1	1		1					2		1		1
AVG	2	0.6	0.4	-	2	-	-	-	0.2	2	0.2	0.6	-	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5313**	**Automobile System**	**3**	**0**	**0**	**3**

Course Objective	1. To impart knowledge about various automobile components and subsystems 2. To define various transmission systems of automobiles and to have the practice for assembling and dismantling of engine parts 3. To describe the mechanisms involved in the steering systems and braking systems 4. To classify different suspension systems used in automobile 5. To learn about Electrical system and accessories used in automobiles

Unit	Description	Instructional Hours
	ENGINE COMPONENTS	
I	Principles of IC Engines - Engine Terminology - Types of Engines: Petrol & Diesel - Two Stroke and Four 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	9
	TRANSMISSION SYSTEMS	
II	Clutch - Construction of Electromagnetic - Mechanical - Hydraulic – Vacuum clutches. Gear Boxes: Manual and Automatic - Over Drives - Transfer Box - Fluid Flywheel - Torque Converter - Propeller Shaft - Slip Joint - Universal Joints - Differential and RearAxle - Case Study on Lightweight Chassis	9
	STEERING AND BRAKES	
III	Constructional details of steering linkages. Different types of steering gear boxes. Steering linkages and layouts. Power and Power assisted steering, Wheels and Tyres - Wheel Alignment Parameters - Steering Geometry. Braking System: Classification ofbrakes, drum brake & disc brakes. Constructional details-Theory of braking. Mechanical hydraulic and Pneumatic brakes	9
	SUSPENSION SYSTEMS	
IV	Basic Requirements - Functions - Types of Suspension Springs - Plastic, Air and Independent Suspension System - Shock Absorbers - Air suspension - Hydrolastic suspension - Trouble Shooting.	9
	ELECTRICAL SYSTEM AND ACCESSORIES	
V	Types of Batteries - Construction, Operation and Maintenance - Lighting – Wiring Circuit - Head Lights - Switches - Indicating Lights - Trouble Shooting - Direction Indicators - Windscreen Wiper - Horn - Speedometer - Heaters - Air conditioner.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Explain various components in automobiles and also compare petrol and diesel engine CO2: Describe the working of manual and automatic transmission CO3: Apply the steering mechanism in developing a new vehicle CO4: Design and develop a suspension vehicle system CO5: Integrate various electrical systems and accessories with vehicle battery

TEXT BOOKS:

T1-Kirpal Singh, "*Automobile Engineering Vol. 1 and 2*", 7th Edition, Standard Publishers, New Delhi, 2011.
T2-H. M. Sethi, "*Automobile Technology*", 1st Edition, Tata McGraw Hill Publishing Company Limited,NewDelhi, 2007.

REFERENCE BOOKS:

R1-Jain K.K. and Asthana .R.B, "*Automobile Engineering*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2002.
R2-William H crouse, Donald T Anglin, "*Automotive Mechanics*", 10th Edition, Butterworth Publishers, 2017.
R3-Joseph Heitner, "*Automotive Mechanics*," 2nd Edition, East-West Press, 1999.
R4-Ganesan V, "*Internal Combustion Engine*", 3rd Edition, Tata McGraw Hill Publishing, NewDelhi, 2012.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1	1	
CO2	1		3									1	2	
CO3			2		1								2	
CO4			3										3	
CO5	1		1									1	1	
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	1.8	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5314**	**Automotive Electronics**	**3**	**0**	**0**	**3**
Course Objective	1. To impart knowledge about the evolution of electronics in Automobile and its Emission Standard 2. To classify various ignition and Injection system 3. To identify various sensors and Actuators used in Automobiles 4. To familiarize with different Engine Control Management 5. To expose the safety systems used in Automobiles					

Unit	Description	Instructional Hours
	ELECTRONICS IN AUTOMOBILES	
I	Evolution of Electronics in Automobiles - Emission Laws - Introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards and Euro VI standards - Emission Control Management. Charging Systems: Working and Design of Charging Circuit Diagram - Requirements of Starting System	9
	IGNITION AND INJECTION SYSTEMS	
II	Ignition Fundamentals - Electronic Ignition Systems - Distribution Less Ignition - Direct Ignition - Spark Plugs - Carburetion - Study of Fuel Injector - Petrol Fuel Injection - Diesel Fuel Injection.	9
	SENSOR AND ACTUATORS	
III	Working Principle and Characteristics of Airflow Rate, Engine Crankshaft Angular Position, Hall Effect, Exhaust Gas Oxygen Sensors - Exhaust Gas Recirculation Actuators, Stepper Motor Actuator, and Vacuum Operated Actuator.	9
	ENGINE CONTROL SYSTEMS	
IV	Control Modes for Fuel Control - Engine Control Subsystems - Ignition Control Methodologies - **Different ECU's used in the Engine Management** - Vehicle Networks: CAN Standard, Format of CAN Standard - Diagnostics Systems in Modern Automobiles	9
	INFOTAINMENT AND SAFETY SYSTEMS	
V	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 -Climate Control of Cars	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Apply the basics of electronics and Emission controls Techniques in Automobiles CO2: Select proper Ignition and Injection system for an Automobile CO3: Compile different sensors and actuators used in automobile industries CO4: Conclude a electronic control unit to be used in an Automobile CO5: Design and develop the safety system in Automobiles

TEXT BOOKS:

T1-Ribbens, "*Understanding Automotive Electronics*", 7th Edition (Indian Reprint), Elsevier, 2013.
T2-Tom Denton," *Automobile Electrical and Electronics Systems*", 4th Edition, Edward Arnold Publishers, 2012

REFERENCE BOOKS:

R1-Tim, Gilles, "*Automotive Engines: Diagnosis, Repair, Rebuilding*", 7th Edition, Delmar Publishers, New York, 2015.
R2-Barry Hollembeak, "*Automotive Electricity, Electronics & Computer Controls*", 1st Edition, Delmar Publishers, 2001.
R3-Ronald. K. Jurgon, "*Automotive Electronics Handbook*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, NewDelhi, 1999.
R4-Robert Bosch GmbH, "*Automotive Hand Book*", 9th Edition, Wiley& Sons Inc., New York, 2014. R5- Powertrain,"World wide emission standards and related regulations", siemens, 2020

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	3	1	3	3					3	3	
CO2	3		3	2		2	2					3	2	
CO3	2	2	2	2	2	2	2					3	2	
CO4	2	2	3	2	3	1	2					3	3	
CO5	2		1	2		2	3					3	2	
AVG	2.4	1.4	2.2	2.2	1.2	2	2.4	-	-	-	-	3	2.4	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5315**	**Electrical Vehicles**	**3**	**0**	**0**	**3**

Course Objective	1. To summarize the developments of electrical vehicles 2. To discuss the hybrid vehicles design considerations 3. To extend design consideration to ancillary systems 4. To familiarize battery and novel energy sources 5. To learn about electric vehicle modeling

Unit	Description	Instructional Hours
	OVERVIEW OF ELECTRICAL VECHICLE SYSTEM	
I	Electrical Vehicle Systems - History of Electric Vehicles - Components - Social and Environmental Importance of Electric Vehicles - Types of Electric Vehicle in use Today-Electric Vehicles for the Future.	9
	HYBRID VECHICLE DESIGN CONSIDERATIONS	
II	Introduction- Aerodynamic Considerations – Consideration of Rolling Resistance - Transmission Efficiency - Consideration of Vehicle Mass - Electric Vehicle Chassis and Body Design-General Issues in Design.	9
	DESIGN OFANCILLARY SYSTEMS	
III	Introduction - Heating and Cooling Systems - Design of the Controls - Power Steering –Choice of Tyres-Wing Mirrors, Aerials and Luggage Racks-Electric Vehicle Recharging and Refuelling Systems.	9
	BATTERY AND NOVEL ENERGY SOURCES	
IV	Introduction-Battery Parameters-Lead Acid Battery-Nickel Based Batteries-Sodium Based Batteries - Lithium Batteries - Battery Charging - Use of Battery in Hybrid Vehicle Fuel Cell Based Energy Storage, Solar Photovoltaic - Wind Power -Flywheels –Super Capacitors-Supply Rails.	9
	ELECTRIC VEHICLE MODELLING AND CASE STUDIES	
V	Introduction-Tractive Effort- Modelling Vehicle Acceleration- Modelling Electric Vehicle Range. Case Studies: Rechargeable Battery Vehicles-Hybrid Vehicles-Fuel Cell Powered Bus.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1:Classify electric vehicle and its components CO2:Calculate the vehicles design considerations CO3:Develop the ancillary systems and its design CO4:Compare various energy storage devices and energy sources CO5:Conclude the performance of the electrical vehicle using modeling

TEXT BOOKS:

T1- James Larminie,"*John Lowry, Electric Vehicle Technology Explained*",2nd Edition, John Wiley & Sons Ltd., New Delhi, 2012.

T2- Iqbal Hussein,"*Electric and Hybrid Vehicles: Design Fundamentals*",2ndEdition,CRCPress,NewYork,2011.

REFERENCEBOOKS:

R1Mehrdad Ehsani, YimiGao, Sebastian E.Gay, AliEmadi," *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*",2ndEdition, CRCPress,NewYork,2009.

R2ThomasJ.,Frank,Benjamin,"*Hybrid Systems, Optimal Control and Hybrid Vehicles*",1stEdition,Springer International Publishing,2017.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	1	1	1	1	1	1			1	3	3
CO2	2	2	3	1	1	1	1	1	1			1	2	3
CO3	2	2	2	1	1	1	1	1	1			1	2	3
CO4	2	2	2	1	1	1	1	1	1			1	2	3
CO5	2	2	2	1	1	1	1	1	1			1	2	3
AVG	2	2	2.2	1	1	1	1	1	1	-	-	1	2.2	3

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5316**	**Mobile Robotics**	**3**	**0**	**0**	**3**
Course Objective	1. Design and Kinematic modeling of Mobile robots 2. Develop the Path and Trajectory for the Robot 3. Identify the Robot performance characteristics through Sensors 4. Locate the Robot and Mapping 5. Write algorithms in Path Planning and Navigation					
Unit	**Description**			**Instructional Hours**		
	MOBILE ROBOT					
I	Introduction - Locomotion, Classification - Legged, Wheeled, Aerial. Key Issues in Locomotion. Mobile Robot Kinematics - Kinematic Model - Forward Kinematic Model, Representing Position, Wheel Kinematic Constraints and Robot Kinematic Constraints.				9	
	ROBOT MANEUVERABILITY AND WORKSPACE					
II	Degree of Mobility - Degree of Steerability - Robot Maneuverability - Degrees of Freedom - Holonomic Robots - Path and Trajectory Considerations - Motion Control -Open Loop Control and Feedback Control.				9	
	PERCEPTION					
III	Sensors for Mobile Robots - Classification, Performance, Uncertainty in Sensors, Wheel Sensor - Heading Sensor- Accelerometers - Inertial Measurement - Motion Sensor - Range Sensors - Vision Sensor - Basics of Computer Vision, Image Processing Techniques, Feature Extraction - Image, Range Data Location Recognition.				9	
	LOCALIZATION					
IV	Major Challenges, Localization Based Navigation. Belief Representation, Map Representation, Probabilistic Map - Examples of Localization Systems - Autonomous Map Building.				9	
	PLANNING AND NAVIGATION					
V	Planning and Reaction - Path Planning - Graph search, Potential field - Obstacle Avoidance - Bug Algorithm, Histogram, Curvature Velocity Techniques - Navigation Architecture - Case Studies on Rock Climbing.				9	
		Total Instructional Hours			45	
	On completion of the course the students will be able to					
Course Outcome	CO1: Design and Modeling of Mobile Robots CO2: Model the Trajectory Path of the Robot CO3: Interpret various Sensors used for Perception CO4: Prepare Localizing and Mapping the Robot CO5: Develop the Navigation Path of the Robot					
TEXT BOOKS:						
T1- Siegwart, Nourbakhsh, *"Introduction to Autonomous Mobile Robots"*, 2nd Edition, MIT Press, 2011. T2- Siciliano. et.al, *"Robotics: Modelling, Planning and Control"*, 4th Edition, Springer, 2013.						
REFERENCE BOOKS:						
R1- Choset Et. al, *"Principles of Robot Motion: Theory, Algorithm & Implementations"*, 3rd Edition, MIT Press, 2011. R2- Siciliano, Khatib, Eds., *"Handbook of Robotics"*, 4th Edition, Springer, 2008. R3- Thrun, Burgard, Fox, *"Probabilistic Robotics"*, 1st Edition, MIT Press, 2010. R4- Roland Siewart et al, "Introducton to Autonomous Mobile Robotics", 2nd Edition, PHI Learning Pvt Ltd, 2011.						
WEB REFERENCES:						
1. http://www.intechopen.com/books/mobile - robots - current – trends 2. http://www.telegraph.co.uk/lifestyle/pets/10200202/Official - studies - strengthen - case - for electric - collar - ban – says - dog - group.html 3. http://cw.routledge.com/textbooks/eresources/9780750651868/casestudies - 12.doc						

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1		1
CO2	1		3									1		2
CO3			2		1									2
CO4			3											3
CO5	1		1									1		1
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	-	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5317**	**Artificial Human Robotics**	**3**	**0**	**0**	**3**
Course Objective	1. To know the basic knowledge about Humanoid robots. 2. To impart knowledge in kinematics of humanoids. 3. To learn about the dynamics in humanoid robots. 4. To understand the basic in biped walking. 5. To know about the different walking patterns					
Unit	**Description**				**Instructional Hours**	
	INTRODUCTION					
I	Historical development of Humanoids, Human Likeness of a Humanoid Robot, Trade-Offs in Humanoid Robot Design, Human-Friendly Humanoid Robot Design, characteristics of humanoid robots.				9	
	KINEMATICS					
II	Kinematic structure, forward and inverse kinematic problems, differential kinematics, Twist, Spatial Velocity, and Spatial Transform, Inverse Differential Kinematic Relations. Differential kinematics at singular configurations- Gait Analysis				9	
	ZMP AND DYNAMICS					
III	ZMP Overview,2D Analysis,3D Analysis, Measurement of ZMP, General Discussion- ZMP of Each Foot, ZMP for Both Feet Contact, Dynamics of Humanoid Robots, Humanoid Robot Motion and Ground Reaction Force , Momentum, Angular Momentum, Angular Momentum and Inertia Tensor of Rigid Body, Calculation of Robot's Center of Mass, Link Speed and Angular Velocity, Calculation of Robot's Momentum and Angular Momentum				9	
	BIPED WALKING					
IV	Two Dimensional Walking Pattern Generation, Two Dimensional Inverted Pendulum, Behavior of Linear Inverted Pendulum, Orbital Energy, Support Leg Exchange, Planning a Simple Biped Gait, Extension to a Walk on Uneven Terrain.				9	
	WALKING PATTERN GENERATION					
V	ZMP Based Walking Pattern Generation, Cart-Table Model, Off-Line Walking Pattern Generation, Stabilizer, Principles of Stabilizing Control, Stabilizing Control of Honda Humanoid Robot, Advanced Stabilizers.				9	
		Total Instructional Hours			45	
	On completion of the course the students will be able to					
Course Outcome	CO 1: Describe about the evolution of Humanoid robots CO 2: Expose the basic knowledge in kinematics of humanoids. CO 3: Calculate the Humanoid Robot Motion and Ground Reaction Force. CO 4: Identify Two-Dimensional Walking pattern on different terrain. CO 5: Create the Walking Pattern models					
TEXT BOOKS:						
T1-Dragomir N. Nenchev, Atsushi Konno, "Humanoid Robots Modeling and Control", Butterworth Heinemann, 2019 T2- Shuuji K, Hirohisa H, Kensuke H, Kazuhito, Springer-Verlag GmbH "Introduction to Humanoid Robotics", Springer, London, 2014. T3-Goswami Ambarish, Vadakkepat Prahlad, "Humanoid Robotics: A Reference", Springer, 2019. T4-J. Craig, "Introduction to Robotics: Mechanics and Control", Fourth Edition, Pearson, 2022						
REFERENCE BOOKS:						
R1-A. Goswami, P. Vadakkepat (Eds.), "Humanoid Robotics: A Reference", Springer, Netherlands, Dordrecht, 2018 R2-J K. Harada, E. Yoshida, K. Yokoi (Eds.), "Motion Planning for Humanoid Robots", Springer, London, 2010. R3-Lorenzo Sciavicco and Bruno Siciliano, "Modelling and Control of Robot Manipulators", second edition, Springer, 2000. R4-Jean-Claude Latombe, "Robot Motion Planning", Kluwer Academy Publishers, 2004.						

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	1	2	2						1	2	2	3
CO2	3	2	1	2	2						1	2	2	3
CO3	3	2	1	2	2						1	2	2	3
CO4	3	2	1	2	2						1	2	2	3
CO5	3	2	1	2	2						1	2	2	3
AVG	3	2	1	2	2	-	-	-			1	2	2	3

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	**22MT5318**	**Micro Robotics**	**3**	**0**	**0**	**3**
Course Objective	1. To expose students to the fundamental aspects of the emerging field of micro robotics. 2. To expose students to micro scale, technologies for fabricating small devices, bio-inspired design, and applications of the field. 3. To expose students to various Mathematical formalism for flexures, Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuator and other sensors. 4. To apply micro robotics to various applications 5. To engage students in implementation of microrobotics					
Unit	**Description**			**Instructional Hours**		
	INTRODUCTION TO MICROROBOTICS					
I	Introduction to Micro robotics -MST (Micro System Technology) - Micromachining - Working principles of Microsystems Applications of Microsystems - Micro-fabrication principles-Design selection criteria for micromachining - Packaging and Integration aspects - Micro-assembly platforms and manipulators				9	
	SCALING LAWS AND MATERIALS FOR MEMS					
II	Introduction - Scaling laws - Scaling effect on physical properties scaling effects on Electrical properties - scaling effect on physical forces - Physics of Adhesion - Silicon - compatible material system - Shape memory alloys - Material properties - Piezoresistivity, Piezoelectricity and Thermoelectricity				9	
	FLEXURES, ACTUATORS AND SENSORS					
III	Elemental flexures - Flexure systems - Mathematical formalism for flexures - Electrostatic actuators - Piezo-electric actuators - Magneto-strictive actuators - Electromagnetic sensors - Optical-based displacement sensors - Motion tracking with microscopes				9	
	MICROROBOTICS					
IV	Introduction - Task specific definition of micro-robots - Size and Fabrication Technology based definition of micro- robots - Mobility and Functional-based definition of micro-robots - Applications for MEMS based micro-robots.				9	
	IMPLEMENTATION OF MICROROBOTS					
V	Arrayed actuator principles for micro-robotic applications - Micro-robotic actuators - Design of locomotive micro-robot devices based on arrayed actuators - Micro-robotics devices - Micro-grippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots - Multi-robot system: Micro-robot powering, Micro-robot communication.				9	
		Total Instructional Hours			45	
	On completion of the course the students will be able to					
Course Outcome	CO1: Explain and apply the concepts of mass, energy, and momentum balance in microrobotics. CO2: Apply adapt, and synthesize learned engineering skills to create microrobot. CO3: Modelmicrorobots for different robotics applications CO4: Formulate the specifications and design of mechatronic systems. CO5: Program the Microrobot for different robotics applications					
TEXT BOOKS:						
T1-Mohamed Gad-el-Hak , "The MEMS Handbook", 2nd Edition, CRC Press, New York, 2019. T2-Yves Bellouard, "Microrobotics Methods and Applications", CRC Press, Massachusetts, 2019.						
REFERENCE BOOKS:						
R1-NadimMaluf and KirtWilliams, "An Introduction to Microelectromechanical systems Engineering", 2nd edition, Artech House, 2004. R2-Julian W Gardner, "Microsensors: Principles and Applications", 2nd edition, Wiley, 2007. R3-MetinSitti, "Mobile Microrobotics", MIT Press, 2017. R4- Nicolas Chaillet, Stephane Rangier "Microrobotics for Micromanipulation", John Wiley & Sons, 2013.						

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	1	2	2						1	2	2	3
CO2	3	2	1	2	2						1	2	2	3
CO3	3	2	1	2	2						1	2	2	3
CO4	3	2	1	2	2						1	2	2	3
CO5	3	2	1	2	2						1	2	2	3
AVG	3	2	1	2	2	-	-	-			1	2	2	3

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Department of Mechatronics Engineering

Syllabus Revision carried out in 2024-2025 ODD Semester

2019 Regulation – 2021 Batch VII semester- Syllabus revision

S. NO	YEAR	SEM	COURSE CODE& NAME	SUGGESTION BY EXPERTS	EXISTING CONTENT	REVISED CONTENT	TYPE OF REVISION	% OF REVISION
NIL								
						Total Percentage Changes		Nil

New Course Introduced (2019 Regulation) – 2021 Batch VII semester

S. No	Regulation	Course Code with Name	Credits
NIL			

Chairman, Board of studies

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Dean Academics

Dean (Academics)
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DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. MECHATRONICS ENGINEERING (UG)

REGULATION-2019

For the students admitted during the academic year 2021-2022 and onwards

SEMESTER I

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2.	21MA1102	Calculus and Linear Algebra	BS	3	1	0	4	40	60	100
THEORY & LAB COMPONENT										
3.	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4.	21CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5.	21CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6.	21ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
7.	21HE1701	Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
8.	21HE1072	Career Guidance – Level I Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
9.	21HE1073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
			Total:	**15**	**2**	**11**	**20**	**550**	**350**	**900**
As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course										

SEMESTER II

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100

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2.	21MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	40	60	100
3.	21ME2101	Engineering Mechanics	ES	3	0	0	3	40	60	100
THEORY & LAB COMPONENT										
4.	21PH2151	Material Science	BS	2	0	2	3	50	50	100
5.	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
6.	21MT2153	Basics of Mechatronics Engineering	ES	2	0	2	3	50	50	100
PRACTICALS										
7.	21GE2001	Engineering Practices Lab	ES	0	0	4	2	60	40	100
8.	21HE2701	Language Competency Enhancement Course - II	HS	0	0	1	1	100	0	100
MANDATORY COURSES										
9.	21HE2072	**Career Guidance Level – II** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
			Total:	**16**	**2**	**11**	**22**	**475**	**425**	**900**

SEMESTER III

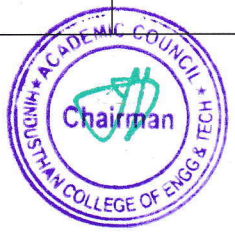
S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	21MA3101	Fourier Series and Statistics	BS	3	1	0	4	40	60	100
2.	21MT3201	Mechanics of solids	PC	3	1	0	4	40	60	100
3.	21MT3202	Industrial Motor Control	PC	3	0	0	3	40	60	100
4.	21MT3203	Digital Electronics in Mechatronics Systems	PC	3	0	0	3	40	60	100
THEORY AND LAB COMPONENT										
5.	21MT3251	Production Technology	PC	2	0	2	3	50	50	100
PRACTICALS										
6.	21MT3001	Computer Aided Drafting Laboratory	PC	0	0	3	1.5	60	40	100
7.	21MT3002	Industrial Motor Control Laboratory	PC	0	0	3	1.5	60	40	100
MANDATORY COURSES										
8.	21MC3191	Indian Constitution	MC	2	0	0	0	100	0	100
9.	21HE3072	**Career Guidance Level – III** Personality, Aptitude and CareerDevelopment	EEC	2	0	0	0	100	0	100
10.	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
			Total	**19**	**2**	**8**	**20**	**630**	**370**	**1000**

SEMESTER IV

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	**21MA4101**	Numerical Methods	BS	3	1	0	4	40	60	100
2.	**21MT4201**	Microcomputer Systems and Microcontroller	PC	3	0	0	3	40	60	100
3.	**21MT4202**	Thermodynamics and Fluid Engineering	PC	3	1	0	4	40	60	100
4.	**21MT4203**	Theory of Machines	PC	3	1	0	4	40	60	100
THEORY AND LAB COMPONENT										
4.	**21MT4251**	Sensors and Signal Conditioning	PC	2	0	2	3	50	50	100
PRACTICALS										
6.	**21MT4001**	Assembly Programming and Interfacing Laboratory	PC	0	0	3	1.5	60	40	100
7.	**21MT4002**	Solid and Fluid Mechanics & Machinery Laboratory	PC	0	0	3	1.5	60	40	100
MANDATORY COURSES										
8.	**21MC4191**	Essence of Indian tradition knowledge/Value Education	MC	2	0	0	0	100	0	100
9.	**21HE4072**	**Career Guidance Level – IV** Personality, Aptitude andCareer Development	EEC	2	0	0	0	100	0	100
10.	**21HE4073**	Ideation Skills	EEC	2	0	0	0	100	0	100
			Total	**20**	**2**	**10**	**21**	**630**	**370**	**1000**

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
1.	**21MT5201**	Machine Design	PC	3	1	0	4	40	60	100
2.	**21MT5202**	Industrial Automation and Control	PC	3	0	0	3	40	60	100
3.	**21MT5203**	Control of Mechatronics Systems	PC	3	0	0	3	40	60	100
4.	**21MT53XX**	**Professional Elective - I**	PE	3	0	0	3	40	60	100



THEORY WITH LAB COMPONENT										
7.	**21MT5251**	Fluid Power Systems	PC	2	0	2	3	50	50	100
8.	**21MT5252**	Object Oriented Programming	PC	2	0	2	3	50	50	100
PRACTICALS										
9.	**21MT5001**	Computer Aided Machine Drawing Laboratory	PC	0	0	3	1.5	60	40	100
10.	**21MT5002**	Industrial Automation and Control Laboratory - I	PC	0	0	3	1.5	60	40	100
MANDATORY COURSES										
11.	**21HE5071**	Soft Skills - I	EEC	1	0	0	1	100	0	100
12.	**21HE5072**	Design Thinking	EEC	1	0	0	1	100	0	100
			TOTAL	**18**	**1**	**10**	**24**	**580**	**420**	**1000**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
THEORY										
1.	**21MT6181**	Total Quality Management	HS	3	0	0	3	40	60	100
2.	**21MT6201**	Design of Mechatronics Systems	PC	3	0	0	3	40	60	100
3.	**21MT6202**	CNC Technology	PC	3	0	0	3	40	60	100
4.	**21MT63XX**	**Professional Elective - II**	PE	3	0	0	3	40	60	100
5.	**21XX6401**	**Open Elective – I**	OE	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
6.	**21MT6251**	Vetronics	PC	2	0	2	3	50	50	100
PRACTICALS										
7.	**21MT6001**	CNC Laboratory	PC	0	0	3	1.5	60	40	100
8.	**21MT6002**	Industrial Automation and Control Laboratory - II	PC	0	0	3	1.5	60	40	100
9.	**21MT6701**	Inplant Training / Internship *	EEC	0	0	0	1	60	40	100

MANDATORY COURSES										
10.	21HE6071	Soft Skill II	EEC	1	0	0	1	100	0	100
11.	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
			TOTAL	**16**	**0**	**8**	**24**	**630**	**470**	**1100**

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	21MT5301	Engineering Metrology and Measurements	PE	3	0	0	3	40	60	100
2	21MT5302	Non-Traditional Machining Techniques	PE	3	0	0	3	40	60	100
3	21MT5303	Automobile Systems	PE	3	0	0	3	40	60	100
4	21MT5304	Operational Research	PE	3	0	0	3	40	60	100
5	21MT5305	Materials Science and Applications	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE II										
1	21MT6301	Embedded System	PE	3	0	0	3	40	60	100
2	21MT6302	Discrete Event System Simulation	PE	3	0	0	3	40	60	100
3	21MT6303	Product Design and Development	PE	3	0	0	3	40	60	100
4	21MT6304	Non-Destructive Testing Techniques	PE	3	0	0	3	40	60	100
5	21MT6305	Distinctive Electrical Machines	PE	3	0	0	3	40	60	100

OPEN ELECTIVE

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	21MT6401	Industrial Safety and Environment	OE	3	0	0	3	40	60	100

SEMESTER VII

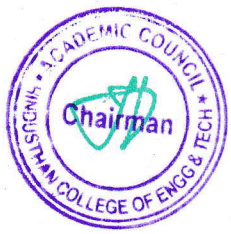
S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
THEORY										
1.	**21MT7201**	Virtual Instrumentation and Human Machine Interface	PC	3	1	0	4	40	60	100
2.	**21MT7202**	Machine Vision Systems	PC	3	0	0	3	40	60	100
3.	**21MT73XX**	**Professional Elective - III**	PE	3	0	0	3	40	60	100
4.	**21XX7401**	**Open Elective – II**	OE	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5.	**21MT7251**	Industrial Robotics	PC	2	0	3	3.5	50	50	100
PRACTICALS										
6.	**21MT7001**	CAE Laboratory	PC	0	0	3	1.5	60	40	100
PROJECT WORK										
7.	**21MT7901**	Project Phase – I	EEC	0	0	4	2	60	40	100
			TOTAL	**14**	**1**	**10**	**20**	**330**	**370**	**700**

PROFESSIONAL ELECTIVE III

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	**21MT7301**	Mobile Robotics	PE	3	0	0	3	40	60	100
2.	**21MT7302**	Textile Automation	PE	3	0	0	3	40	60	100
3.	**21MT7303**	Medical Mechatronics	PE	3	0	0	3	40	60	100
4.	**21MT7304**	Disaster Management	PE	3	0	0	3	40	60	100
5.	**21MT7305**	Factory Automation	PE	3	0	0	3	40	60	100

OPEN ELECTIVE

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	**21MT7401**	Project Management	OE	3	0	0	3	40	60	100

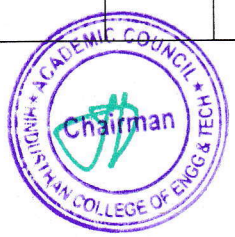


SEMESTER VIII

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	**21MT83XX**	**Professional Elective - IV**	PE	3	0	0	3	40	60	100
2.	**21MT83XX**	**Professional Elective - V**	PE	3	0	0	3	40	60	100
PRACTICAL										
3.	**21MT8901**	Project Work – Phase II	EEC	0	0	16	8	100	0	100
			TOTAL	**6**	**0**	**16**	14	180	120	**300**

PROFESSIONAL ELECTIVE IV										
1.	**21MT8301**	Rapid Prototyping and Reverse Engineering	PE	3	0	0	3	40	60	100
2.	**21MT8302**	Industrial IoT	PE	3	0	0	3	40	60	100
3.	**21MT8303**	Artificial Intelligence for Mechatronics Engineering	PE	3	0	0	3	40	60	100
4.	**21MT8304**	MEMS and Nano Technology	PE	3	0	0	3	40	60	100
5.	**21MT8305**	Information System for Engineers	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE V										
S.No.	**Course Code**	**Course Title**	**Type**	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1.	**21MT8306**	Machineries in Agriculture	PE	3	0	0	3	40	60	100
2.	**21MT8307**	Industrial Diagnostics and Maintenance Techniques	PE	3	0	0	3	40	60	100
3.	**21MT8308**	Engineering Economics and Cost Analysis	PE	3	0	0	3	40	60	100
4.	**21MT8181**	Principles of Management	PE	3	0	0	3	40	60	100
5.	**21MT8182**	Professional Ethics in Engineering	PE	3	0	0	3	40	60	100



LIST OF OPEN ELECTIVES – MECHATRONICS ENGINEERING

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
	LIFE SKILL COURSES									
1.	**21LSZ401**	General Studies for Competitive Examinations	OE	3	0	0	3	40	60	100
2.	**21LSZ402**	Human Rights, Women's Rights and Gender Equality	OE	3	0	0	3	40	60	100
3.	**21LSZ403**	Indian Ethos and Human Values	OE	3	0	0	3	40	60	100
4.	**21LSZ404**	Indian Constitution and Political System	OE	3	0	0	3	40	60	100
5.	**21LSZ405**	Yoga for Human Excellence	OE	3	0	0	3	40	60	100

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

Note: Each programme should provide verticals for minor degree

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	**21MT5601**	Sem 5: Basics of Mechatronics System	MDC	3	0	0	3	3
2.	**21MT6601**	Sem 6: Sensors and Interfacing	MDC	3	0	0	3	3
3.	**21MT6602**	Sem6: Hydraulics and Pneumatics	MDC	3	0	0	3	3
4.	**21MT7601**	Sem 7: PLC and SCADA	MDC	3	0	0	3	3

5.	**21MT7602**	Sem 7: Robotics and its applications	MDC	3	0	0	3	3
6.	**21MT8601**	Sem 8: Design of Mechatronics System	MDC	3	0	0	3	3

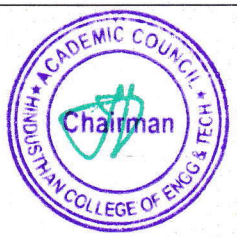
*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I **Fintech and Block Chain**	**Vertical II** **Entrepreneurship**	**Vertical III** **Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Green Technology
Introduction to Fintech	Financing New Business Ventures	Environmental Quality Monitoring and Analysis

VERTICALS FOR HONOURS DEGREE

Vertical I **Industrial Automation**	**Vertical II** **Medical Mechatronics**	**Vertical III** **Applied Robotics**
21MT5204 Concepts of Machines and Mechanisms	21MT5205 Robotics in Medicine	21MT5206 Robots and Systems in Smart Manufacturing
21MT6203 Drives and Actuators for Automation	21MT6205 Brain Computer Interface and its Applications	21MT6207 Medical Robotics
21MT6204 Power Electronics	21MT6206 Digital Image Processing	21MT6208 Agricultural Robotics and Automation
21MT7203 Advanced PLC	21MT7205 Radiological Equipment	21MT7207 Collaborative Robotics
22MT7204 Distributed Control System	21MT7206 Biomaterials	21MT7208 Robot Operating Systems
22MT8201 HMI & SCADA	22MT8202 Bionics	22MT8203 Humanoid Robotics



B Tech (Hons) Mechatronics Engineering Specialization in Industrial Automation

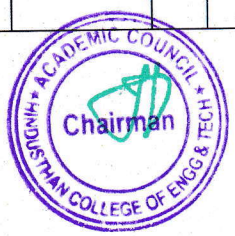
S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1	21MT5204	Sem 5: Concepts of Machines and Mechanisms	PC	3	0	0	3	3	40	60	100
2	21MT6203	Sem 6: Drives and Actuators for Automation	PC	3	0	0	3	3	40	60	100
3	21MT6204	Sem 6: Power Electronics	PC	3	0	0	3	3	40	60	100
4	21MT7203	Sem 7: Advanced PLC	PC	3	0	0	3	3	40	60	100
5	21MT7204	Sem 7: Distributed Control System	PC	3	0	0	3	3	40	60	100
6	21MT8201	Sem 8: HMI & SCADA	PC	3	0	0	3	3	40	60	100

B Tech (Hons) Mechatronics Engineering Specialization in Medical Mechatronics

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	21MT5205	Sem 5: Robotics in Medicine	PC	3	0	0	3	3	40	60	100
2.	21MT6205	Sem 6: Brain Computer Interface and its Applications	PC	3	0	0	3	3	40	60	100
3.	21MT6206	Sem 6: Digital Image Processing	PC	3	0	0	3	3	40	60	100
4.	21MT7205	Sem 7: Radiological Equipments	PC	3	0	0	3	3	40	60	100
5.	21MT7206	Sem 7: Biomaterials	PC	3	0	0	3	3	40	60	100
6.	21MT8202	Sem 8: Bionics	PC	3	0	0	3	3	40	60	100

B Tech (Hons) Mechatronics Engineering with Specialization in Applied Robotics

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	21MT5206	Sem 5: Robots and Systems in Smart Manufacturing	PC	3	0	0	3	3	40	60	100



2.	21MT6207	Sem 6: Medical Robotics	PC	3	0	0	3	3	40	60	100
3.	21MT6208	Sem 6: Agricultural Robotics and Automation	PC	3	0	0	3	3	40	60	100
4.	21MT7207	Sem 7: Collaborative Robotics	PC	3	0	0	3	3	40	60	100
5.	21MT7208	Sem 7: Robot Operating Systems	PC	3	0	0	3	3	40	60	100
6.	21MT8203	Sem 8: Humanoid Robotics	PC	3	0	0	3	3	40	60	100

Note: Each programme should provide verticals for Honours degree

SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES

S.No.	Course Area	Credits per Semester								
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	4	4	-	-	-	3	-	-	11
2	BSC	10	10	4	4	-	-	-	-	28
3	ESC	3	8	-	-	-	-	-	-	11
4	PCC	-	-	16	17	19	12	12	-	76
5	PEC	-	-	-	-	3	3	3	6	15
6	OEC	-	-	-	-	-	3	3	-	6
7	EEC	3	-	-	-	2	3	2	8	18
8	MCC		✓	✓	✓					
Total		20	22	20	21	24	24	20	14	165

Credit Distribution R2019

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	24	24	20	14	165

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7201	Virtual Instrumentation and Human Machine Interface	3	1	0	4
Course Objective	1. Understand the basic components of virtual instrumentation system 2. To develop a VI program using various techniques 3. Identify elements of data acquisition for software and hardware installation 4. To gain the knowledge about different types of common instrument interfaces 5. To learn to develop applications based on virtual instrumentation system					

Unit	**Description**	**Instructional Hours**
	VIRTUAL INSTRUMENTATION	
I	Conventional and Distributional Virtual Instrumentation(VI) - VI Vs Traditional Instruments - Block Diagram and Architecture of a Virtual Instrument - Hardware and Software in VI - Virtual instrumentation for Test, Control and Design - Virtual instrument in Engineering Process - Graphical Programming in Data Flow - HMI / SCADA Software.	9+3
	VI PROGRAMMING TECHNIQUES	
II	Controlling Programs through Structures: For loops and While loops - Case and Sequence Structures: Flat sequence and Stacked sequence - Shift Register - Feedback Nodes - Formula Nodes - Arrays - Clusters - Error Handling - Waveform Charts and Waveform Graphs - XY Graphs - Strings - File I/O.	9+3
	DATA ACQUISITION BASICS	
III	Concepts of Data Acquisition - Data Acquisition in LabVIEW - Hardware Installation and Configuration - Components of DAQ - DAQ Signal Accessory - DAQ Assistant - DAQ Hardware - DAQ Software.	9+3
	INTERFACING	
IV	Common Instrument Interfaces: RS 232 / RS485 - GPIB - VISA standard - Bus Interfaces: USB-PCI - PCI - X - PXI - PCMCIA - SCXI-VXI - LXI.	9+3
	APPLICATIONS	
V	Application of Virtual Instrumentation: Digital Stop Watch using Lab VIEW - BCD to Seven Segment Decoder - Cruise Control - PID Controller - Client Server Application in LABVIEW - Notifiers, Simple Read Only Server, Two Way Communication, Read Write Server. The students can design anyone of the following 1. Design a Simulator Barometer using LabVIEW. 2. Design a LabVIEW Program to Simulate Virtual Joystick.	9+3
	Total Instructional Hours	45+15=60

	On completion of the course the students will be able to
Course Outcome	CO1: Demonstrate the basic concepts about virtual instrumentation CO2: Develop programming through LabVIEW graphical programming environment CO3: Experiment with data acquisition hardware and LabVIEW software CO4: Apply the knowledge of common instrument interfaces and bus interfaces CO5: Design and develop the industrial applications usingLabVIEW

TEXT BOOKS:

T1- Jovitha Jerome, *"Virtual Instrumentation using Lab VIEW"*, PHI Learning Private Limited, 2012.
T2- S.Sumathi&P.Surekha, *"Virtual Instrumentation with Lab VIEW"*, ACME Learning Private Limited, 2011.

REFERENCE BOOKS:

R1- Sanjay Gupta & Joseph John, *"Virtual Instrumentation using Lab VIEW"*,McGraw Hill Education, NewYork, 2010.
R2- Gary Johnson & Richard Jennings, *"Lab VIEW Graphical Programming"*, 4th Edition, McGraw Hill Education, NewYork, 2006.
R3- Jeffrey Travis & Jim Kring, *"Lab viewfor Everyone"*, PHI Learning Private Limited, 3rd Edition, 2007.
R4- Jeffrey Beyon, "Lab view : Programming, Data Acquisition and Analysis", PHI Learning Private Limited.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3				1							1	3	2
CO2	3	3	3	2	1			3	2		2	2	2	2
CO3	3	3	3	2	2			2	3			2	2	2
CO4	3				2				2			2	1	2
CO5	3	3	3	2	2			1	2		2	2	2	2
AVG	3	1.8	1.8	1.2	1.6	-	-	1.2	1.8	-	0.8	1.8	2	2

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7202	Machine Vision System	3	0	0	3
Course Objective	1. To describe known basic principles of Machine Vision System 2. To study the Image Acquisition and Lighting techniques 3. To review Image processing techniques for Computer Vision 4. To study Mathematical Transforms necessary for Image Processing. 5. To study some applications of Machine Vision Algorithms					
Unit		**Description**		**Instructional Hours**		
	INTRODUCTION					
I	Human vision – Machine vision and Computer vision – Benefits of Machine vision – Block diagram and Function of Machine Vision System Implementation of Industrial Machine Vision System.				9	
	IMAGE ACQUISITION					
II	Lighting Techniques – Types and Selection – Machine Vision Lenses and Optical Filters, Specifications and Selection– Imaging Sensors – CCD and CMOS, Specifications – Interface Architectures – Analog and Digital Cameras – Digital Camera Interfaces – Camera Computer Interfaces.				9	
	IMAGE PROCESSING					
III	Fundamentals of Digital Image – Spatial and Frequency Domain – image segmentation- Thresholding- Grayscale Stretching –Image Smoothing and Sharpening – Edge Detection – Binary Morphology.				9	
	IMAGE ANALYSIS					
IV	Feature Extraction – Region Features, Shape and Size Features – Texture Analysis – Template Matching and Classification – 3D Machine Vision Techniques – Decision Making.				9	
	MACHINE VISION APPLICATIONS					
V	Machine vision Applications in Manufacturing, Electronics, Printing, Pharmaceutical, Textile, Applications in Metrology and Gauging–Bio medical Field, Surveillance, Bio-metrics.				9	
		Total Instructional Hours			45	
	On completion of the course the students will be able to					
Course Outcome	CO1: Implement fundamental required for Machine Vision CO2: Evaluate the techniques for Camera Lighting Interface. CO3: Develop Image Processing techniques for Machine Vision System CO4: Interpret Image Segmentation and Representation Techniques CO5: Develop an application using Machine Vision Techniques					
TEXTBOOKS:						

T1- A. Alexander Hornberg, "*Handbook of Machine Vision*", First Edition, 2006.
T2- Milan Sonaka, Vaclav hlavac, Roger Boyle, *Image processing, analysis and machine vision"* First edition 2007.

REFERENCE BOOKS:

R1- E.R.Davies, "Machine Vision", Third edition, 2006.
R2- Rafael C.Gonzales, Richard.E.Woods, *"Digital Image Processing Publishers"*, Fourth Edition 2007.
R3- Emanuel Trucco, Alessandro Verri, "Introductory Techniques for 3D computer vision", 1st Edition, PHI Learning Private Limited, 2006.
R4- Herbert Freeman, "Machine Vision Algorithms, Architecture and Systems", Academic Press, Inc. 2012.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3		2		3				3	3	3	3	1	1
CO2	1		3						1	1	1	1	2	1
CO3	1		2		3				1	1	1	1	2	2
CO4	1		3										3	2
CO5	1		1									1	1	2
AVG	1.4	-	2.2	-	1.2	-	-	-	1	1	1	1.2	1.8	1.6

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7251	Industrial Robotics	2	0	3	3.5

Course Objective	1. To outline the evolution of robots and its anatomy 2. To describe the various kinematics and inverse kinematics of robot motions 3. To illustrate the principle of robot end effectors 4. To acquire knowledge about basics of robot programming 5. To discuss the applications of robots in industries

Unit	**Description**	**Instructional Hours**
	FUNDAMENTALS OF ROBOTICS	
I	Definition and History of Robotics - Classification of Robots - Robot Anatomy - Robot Coordinates - Workspace - Degrees of Freedom - Asimov's Laws of Robotics. Robot Actuators and Drives.	6
	ROBOT KINEMATICS	
II	Introduction to Robot kinematics - Homogeneous Transformations Forward Kinematics - Denavit - Hartenberg (D-H) Representation - Inverse kinematics. Basics of Trajectory Planning	6
	ROBOT END EFFECTORS	
III	Robot End effectors: Introduction - Types of End Effectors - Mechanical Gripper - Types of Gripper Mechanism - Other Types of Gripper - Special Purpose Grippers - Design Considerations - Tools as End Effector - Robot End Effector Interface.	6
	ROBOT PROGRAMMING	
IV	Robot Programming: Types – Lead through and Textual Programming – Robot Languages - Classification of Robot Language - Computer Control and Robot Software.Val system and languages.	6
	APPLICATIONS OF ROBOT	
V	Machine Interface - Robots in Manufacturing and Non - Manufacturing Applications - Medical Applications - Automation and Mechatronics Applications	6
	Total Instructional Hours	30

LABORATORY COURSES

1. Programming for Point-to-Point Operation and Continuous Path Operation.
2. Programming for Pick and Place Operation with and without delay.
3. Programming for Estimation of Accuracy of a Robot.
4. Programming for Estimation of Repeatability and Resolution of a Robot.
5. Programming for Estimation of work volume for different configuration of Robot.
6. Programming for Loading and Unloading Operations with Different Cycles.
7. Create a Model to Find the Force in Spring Damper at Static Equilibrium and Simulate using ADAMS Software.
8. Create Geometry of the Lift Mechanism and then Set the Constraints of the Model and Simulate using ADAMS Software.

Total Practical Hours	20
Total Instructional Hours	50

	On completion of the course the students will be able to
Course Outcome	CO1: Explain the basic concepts and working of robot. CO2: Analyze the kinematics of robot motions for a given problem CO3: Evaluate and construct a robot end effector for specific applications CO4: Write programs for the given applications CO5: Design a robot for real world problems and applications

TEXT BOOKS:

T1- Mikell P. Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, *"Industrial Robotics Technology, Programmingand Applications "*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi,2012.

T2- Saeed B.Niku *"Introduction to Robotics: Analysis, Systems, Applications"*, 2nd Edition, John Wiley & SonsLtd.,NewDelhi, 2012.

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REFERENCE BOOKS:

R1- Deb. S.R., *"Robotics Technology and Flexible Automation"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited,New Delhi, 2010.

R2- Klafter R.D., Chimielewski T.A., Negin M., *"Robotic Engineering - An integrated approach"*, PHI Learning PrivateLimited, New Delhi, 2003.

R3- Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "*Robotics Control Sensing, Vision and Intelligence*", Tata McGraw HillPublishing CompanyLimited, New Delhi, 2008.

R4- John.J.Craig, " *Introduction to Robotics: Mechanics & control*", Pearson Publication, Fourth edition, 2018.

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1		1
CO2	1		3									1		2
CO3			2		1									2
CO4			3											3
CO5	1		1									1		1
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	-	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		LABORATORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7001	CAE Laboratory	0	0	4	2

Course Objective	1. To introduce fundamentals of the analysis software, its features, and applications 2. To learn the basics of Finite Element analysis 3. To study the various failure modes of engineering components 4. To acquire knowledge on various loads and stresses acting on structures and components 5. To expose the students to different applications of simulation and analysis tools

Unit	**Description of the Experiments**	**Practical Hours**
1	Stress analysis of a plate with a circular hole.	3
2	Stress analysis of rectangular L bracket	3
3	Stress analysis of an axi-symmetric component	3
4	Stress analysis of Cantilever beam	3
5	Stress analysis of Simply supported beam.	3
6	Stress analysis of Fixed beam	6
7	Mode frequency analysis of a 2D component	6
8	Mode frequency analysis of Cantilever beam	3
9	Mode frequency analysis of Aircraft wing	3
10	Thermal stress analysis of a 2D component	3
11	Conductive heat transfer analysis of a 2D component	3
12	Convective heat transfer analysis of a 2D component	6
	Total Practical Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Execute stress calculations for various load conditions. CO2: Perform the stress and deformation analysis of different components CO3: Analyze and simulate deformation plot for structural and thermal loads CO4: Model and analyze the real-world system. CO5: Evaluate the performance of real-world system.

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	2	2	2	2	2	2	2	2	2	2	2	1	1
CO2	3	1	2	1	-	-	-	-	-	-	-	-	2	2
CO3	-	3	3	2	-	-	-	-	1	-	-	-	3	3
CO4	-	1	1	-	-	-	-	-	-	-	-	-	1	1
CO5	2	2	2	2	-	-	-	-	-	-	-	1	2	2
AVG	2.3	1.8	2	1.75	2	2	2	2	1.5	2	2	1.5	1.8	1.8

- 1-low, 2-medium, 3-high, '-'- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B.Tech	21MT7901	PROJECT PHASE I	0	0	4	2

	The student should be made	
Course Objective	1	To acquaint with the process of identifying the needs and converting it into the problem
	2	To familiarize the process of solving the problem in a group.
	3	To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
	4	To inculcate the process of self-learning and research
	5	To prepare the product ideas from the real time problems

Unit	Description	Instructional Hours

Guidelines for Project Phase I

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out by all the groups of the students.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Project Phase I: Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute.
- The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Distribution of Term work marks for both semesters shall be as below;

- Marks awarded by guide/supervisor based on log book : 10
- Marks awarded by review committee : 10
- Quality of Project report : 05

Total Instructional Hours	**45**

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Course Outcome	CO1	Identify problems based on societal /research needs.
	CO2	Apply Knowledge and skill to solve societal problems in a group.
	CO3	Develop interpersonal skills to work as member of a group or leader.
	CO4	Draw the proper inferences from available results through theoretical/ experimental/simulations.
	CO5	Analyse the impact of solutions in societal and environmental context for sustainable development.

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	2	3	3	3	3	3	2	3	2	2	2	3
CO2	3	2	2	3	3	3	3	3	2	3	2	2	2	3
CO3	3	2	2	3	3	3	3	3	2	3	2	2	2	3
CO4	3	2	2	3	3	3	3	3	2	3	2	2	2	3
CO5	3	2	2	3	3	3	3	3	2	3	2	2	2	3
AVG	3	2	2	2	2	2	2	2	2	2	2	2	2	3

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7301	Mobile Robotics	3	0	0	3
Course Objective	1. Design and Kinematic modeling of Mobile robots 2. Develop the Path and Trajectory for the Robot 3. Identify the Robot performance characteristics through Sensors 4. Locate the Robot and Mapping 5. Write algorithms in Path Planning and Navigation					
Unit		**Description**			**Instructional Hours**	
	MOBILE ROBOT					
I	Introduction - Locomotion, Classification - Legged, Wheeled, Aerial. Key Issues in Locomotion. Mobile Robot Kinematics - Kinematic Model - Forward Kinematic Model, Representing Position, Wheel Kinematic Constraints and Robot Kinematic Constraints.				9	
	ROBOT MANEUVERABILITY AND WORKSPACE					
II	Degree of Mobility - Degree of Steerability - Robot Maneuverability - Degrees of Freedom - Holonomic Robots - Path and Trajectory Considerations - Motion Control - Open Loop Control and Feedback Control.				9	
	PERCEPTION					
III	Sensors for Mobile Robots - Classification, Performance, Uncertainty in Sensors, Wheel Sensor - Heading Sensor- Accelerometers - Inertial Measurement - Motion Sensor - Range Sensors - Vision Sensor - Basics of Computer Vision, Image Processing Techniques, Feature Extraction - Image, Range Data Location Recognition.				9	
	LOCALIZATION					
IV	Major Challenges, Localization Based Navigation. Belief Representation, Map Representation, Probabilistic Map - Examples of Localization Systems - Autonomous Map Building.				9	
	PLANNING AND NAVIGATION					
V	Planning and Reaction - Path Planning - Graph search, Potential field - Obstacle Avoidance - Bug Algorithm, Histogram, Curvature Velocity Techniques - Navigation Architecture - Case Studies on Rock Climbing.				9	
		Total Instructional Hours			45	
	On completion of the course the students will be able to					
Course Outcome	CO1: Design and Modeling of Mobile Robots CO2: Model the Trajectory Path of the Robot CO3: Interpret various Sensors used for Perception CO4: Prepare Localizing and Mapping the Robot CO5: Develop the Navigation Path of the Robot					

TEXT BOOKS:

T1- Siegwart, Nourbakhsh, *"Introduction to Autonomous Mobile Robots"*, 2nd Edition, MIT Press, 2011.
T2- Siciliano. et.al, *"Robotics: Modelling, Planning and Control"*, 4th Edition, Springer, 2013.

REFERENCE BOOKS:

R1- Choset Et. al, *"Principles of Robot Motion: Theory, Algorithm & Implementations"*, 3rd Edition, MIT Press, 2011.
R2- Siciliano, Khatib, Eds., *"Handbook of Robotics"*, 4th Edition, Springer, 2008.
R3- Thrun, Burgard, Fox, *"Probabilistic Robotics"*, 1st Edition, MIT Press, 2010.
R4- Roland Siewart et al, "Introducton to Autonomous Mobile Robotics", 2nd Edition, PHI Learning Pvt Ltd, 2011.

WEB REFERENCES:

1. http://www.intechopen.com/books/mobile - robots - current – trends
2. http://www.telegraph.co.uk/lifestyle/pets/10200202/Official - studies - strengthen - case - for electric - collar - ban – says - dog - group.html
3. http://cw.routledge.com/textbooks/eresources/9780750651868/casestudies - 12.doc

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1		1
CO2	1		3									1		2
CO3			2		1									2
CO4			3											3
CO5	1		1									1		1
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	-	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7302	Textile Automation	3	0	0	3
Course Objective	1. To summarize the Basic concepts and list the Basic processing of the Textile Technology 2. To familiarize with the Basics of Spinning 3. To interpret the Basics of Weaving Process and its Variables 4. To operate the Automated Spinning Machines 5. To impart the knowledge about the Basics of Waving Machines					
Unit		**Description**			**Instructional Hours**	
	BASICS OF PROCESSING					
I	History of Textile Technology and its Advancements - Introduction to Textile Fibers - Overview of Textile Manufacturing - Introduction to Automation in Textile Industries - Objectives and Process Variables in Processing Machines - Singeing - Desizing - Scouring - Bleaching - Mercerizing - Dyeing - Printing - Finishing - Robotics in Textile Industries.				9	
	BASICS OF SPINNING					
II	Spinning Process Flow Chart - Objectives and Process Variables of Textile Spinning Machineries - Mixing - Blow Room - Carding - Draw Frame - Combing - Speed Frame - Ring Frame - Rotor Spinning.				9	
	BASICS OF WEAVING					
III	Weaving Process Flowchart - Objectives and Process Variables in Weaving - Preparatory Winding, Warping, Sizing and Beaming - Objectives and Process Variables in Weaving - Drawing In, Knotting, Denting and Weaving.				9	
	AUTOMATION IN SPINNING MACHINERY					
IV	Machinery Material Flow and its Variation Controls - Feeders & Stop Motions - Auto Levelers - Safety Switches - Production and Quality Monitors - Full Doff and Preset Length Monitors - Data Acquisition System for Spinning Preparatory - Ring Spinning - Rotor Spinning - CAD / CAM / CIM in Spinning.				9	
	AUTOMATION IN WEAVING MACHINERY					
V	Yarn Cleaner Controls - Knotter / Splicer Carriage Controls - Warping Machine Monitors and Controls - Sizing Machine Monitors and Controls - Auto Reaching / Drawing In and Knotting Machine Monitors and Controls - Data Acquisition System in Weaving Preparatory and Weaving - Humidification Systems - Weaving, Dyeing, Printing, Apparel Production.				9	
		Total Instructional Hours			45	
	On completion of the course the students will be able to					
Course Outcome	CO1: Evaluate Textile Technology and Manufacturing with Textile Fibers CO2: Describe various process involved in Spinning CO3: List out the various process involved in Weaving CO4: Explain various stages of Automation scopes in Spinning Machinery CO5: Outline the role of computers in Automated Weaving Machinery					

TEXT BOOKS:

T1- Ashok Kumar.L, Senthil Kumar., "*Automation in Textile Machinery: Instrumentation and Control System Design Principles*", 1st Edition, CRC Press, USA, 2018.

T2- J Chattopadhyay R, "*Advances in Technology of Yarn Production*", 1st Edition, NCUTE, IIT Delhi, 2002..

REFERENCE BOOKS:

R1- Krishna Kant, "*Computer Based Industrial Control*", 2nd Edition, PHI Learning Private Limited, New Delhi, 2011.

R2- Oxtoby E, "*Spun Yarn Technology*", New Edition, Butter Worth"s, London, 2012.

R3- R Shishoo, "*The Global Textile and Clothing Industries*", 1st Edition, Woodhead Publications, 2012.R4- P V Vidhyasagar, "*Encyclopedia of Textiles*" Mittal Publications, New Delhi, 2000.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1	1	
CO2	1		3									1	2	
CO3			2		1								2	
CO4			3										3	
CO5	1		1									1	1	
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	1.8	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7303	Medical Mechatronics	3	0	0	3
Course Objective	1. To familiarize the Role of Instrumentation in Medical Applications 2. To introduce the various Sensing and Measurement devices 3. To learn different types of Amplifiers and Filters 4. To discuss the need and technique of Electrical Safety in Hospitals 5. To learn the advanced equipments in Medicine					

Unit	**Description**	**Instructional Hours**
MEDICAL EQUIPMENTS		
I	Cell Structure - Electrode - Electrolyte Interface, Electrode Potential, Resting andAction Potential - Electrodes for their Measurement, ECG, EEG, EMG, Machine Description - Methods of Measurement.	9
SENSORS AND TRANDUCERS IN BIO-MEDICAL APPLICATIONS		
II	Basic Transducer Principles - Types - Resistive, Inductive, Capacitive, Fiber - Optic, Photoelectric, Chemical, Active and Passive Transducers and their Description and Feature Applicable for Biomedical Instrumentation - Bio, Nano Sensors and Application.	9
CONDITIONING, RECORDING AND DISPLAY OF BIOSIGNALS		
III	Input Isolation, DC Amplifier, Charge Amplifier, Power Amplifier and Differential Amplifier - Feedback, Operational Amplifier - Electrometer Amplifier, Carrier Amplifier - Instrument Power Supply, Basis of Signal Conversion and Digital Filtering.	9
MEDICAL SUPPORT		
IV	Blood Pressure Measurement: by Ultrasonic Method - Plethysmography - Blood Flow Measurement by Electromagnetic Flow Meter Cardiac Output Measurement by Dilution Method - Vector Cardiography. Heart Lung Machine - Artificial Ventilator - Anesthetic Machine - Cardiac Pacemaker - DC – Defibrillator- Patient Safety - Electrical Shock Hazards.	9
MEDICAL CASE STUDIES IN MECHATRONICS		
V	Smart Probe for Detecting Kidney Stones, Smart Probe for Breast Cancer, Ankle Sprain, Active Prosthetic Knee, Smart System for Cardiovascular Plaque Detection.	9
	Total Instructional Hours	45

On completion of the course the students will be able to

Course Outcome	CO1: Select modern engineering and Information Technology tools for Engineering Practice CO2: Select different sensors and transducers for Biomedical Instrumentation CO3: Describe the signal conditioning circuits used in Biomedical Engineering CO4: Identify different measurement techniques used in physiological parameters measurement CO5: Analyze the problems in various fields of Medical Practices.

TEXT BOOKS:

Khandpur, R.S., "*Handbook of Biomedical Instrumentation*", 3rd Edition, Tata McGraw Hill Publishing CompanyLimited,NewDelhi, 2014.

SiamakNajarian, JavadDarghai, GoldisDarbemamieh, Siamak H. Farkoush, "*Mechatronics in Medicine - A Biomedical Engineering Approach*" , 1st Edition, Tata McGraw Hill Publishing CompanyLimited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Tompkins W.J., "*Biomedical Digital Signal Processing*", 1st Edition, PHI Learning Private Limited, New Delhi, 2000.

R2- Cromwell, Weibell and Pfeiffer, "*Biomedical Instrumentation and Measurements*", 2nd Edition, PHI Learning Private Limited, New Delhi, 2010.

R3- Arumugam, "*Bio Medical Instrumentation*", Anuradha Agencies Publications, 2002.

Geddes L.A., and Baker, L.E., "*Principles of Applied Bio-medical Instrumentation*", 3rd Edition, John Wiley and Sons,2010

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	1	2	2					1			2	2	2
CO2	2	3	2	2	2							1	2	1
CO3	3	2	2	2	1							3	3	3
CO4	2	2	2	1	1				1	1		2	3	2
CO5	2	2	3	2	1				1	2	3	2	3	3
AVG	2.4	2	2.2	1.8	1	-	-	-	0.6	0.6	0.6	2	2.6	2.2

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7304	Disaster Management	3	0	0	3
Course Objective	3. To provide students an exposure to disasters, their significance and types. 4.To understand the relationship between vulnerability, disasters, disaster prevention and risk reduction3.To explain approaches of psychological impact of disasters 4.To enhance the risk management with respect to India5.To understand the technological disaster					
Unit		**Description**			**Instructional Hours**	
	INTRODUCTION TO DISASTERS					
I	Definition: Disaster, Hazard, Vulnerability, Resilience, Risks - Disasters: Types of disasters - Earthquake, Landslide, Flood, Drought, Fire - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies Climate change- Dos and Don'ts during various types of Disaster.			9	
	APPROACHES TO DISASTER RISK REDUCTION (DRR)					
II	Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake – holders- Institutional Process and Framework at State and Central Level- State Disaster Management Authority(SDMA) - Early Warning System - Advisories from Appropriate Agencies.			9	
	PSYCHOLOGICAL IMPACT OF DISASTERS					
III	Introduction – Approaches and Diagnostic Issues –Principles of psychosocial Intervention -Special Intervention techniques – Stress Reduction Techniques.			9	
	DISASTER RISK MANAGEMENT IN INDIA					
IV	Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation - Role of GIS and Information Technology Components , Risk Assessment, Response and Recovery Phases of Disaster - Disaster Damage Assessment			9	
	TECHNOLOGICAL DISASTER AND CASE STUDIES					
V	Technological disaster - Industrial hazards -Fire hazards - Role of remote sensing - Application of GIS Technology- Accidental Disaster, Case Studies, Space Based Inputs for Disaster Mitigationand Management and field works related to disaster management.			9	
		Total Instructional Hours			45	
	On completion of the course the students will be able to					
Course Outcome	CO1: Differentiate the types of disasters, causes and their impact on environment and society. CO2: Assess vulnerability and various methods of risk reduction measures as well as mitigation.CO3: Interpret the psychological impact and its reduction techniques. CO4: Express the knowledge disaster management with respect to India CO5: Understand the industrial hazard and its management.					

TEXT BOOKS:

T1- Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423

T2- Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367,ISBN-13: 978-1259007361]

T3- KapurAnu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCE BOOKS:

R1- Gupta Anil K, Sreeja S. Nair.Environmental Knowledge for Disaster Risk Management, NIDM, NewDelhi, 2011R2- Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005

R3- Government of India, National Disaster Management Policy,2009.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO2	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO3	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO4	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
CO5	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1
AVG	3	3	2.2	1.2	1	1	-	-	-	-	1	1	1.8	1

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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THEORY COURSES

Programme	Course Code	Name of the Course	L	T	P	C
BE	21MT7305	Factory Automation	3	0	0	3

Course Objective	To impart knowledge of automation in manufacturing industries To classify material handling system and AGVs To study various storage methods and its equipments To learn about manufacturing cells and automated assembly lines To list out different assembly methods in industries

Unit	Description	Instructional Hours
OVERVIEW OF AUTOMATION		
I	Automation in Production Systems - Automation Principles and Strategies - Elements of an Automated System - Advanced Automation Function - Levels of Automation - Hardware Components for Automation and Process Control.	9
MATERIAL TRANSPORT SYSTEM		
II	Introduction - Material Handling equipment - Design considerations in Material Handling - Industrial trucks - Automated guided vehicles - Monorails and other Rail Guided Vehicles - Conveyors - Cranes and Hoists - Analysis of Vehicle Based System - Conveyor Analysis.	9
STORAGE SYSTEM		
III	Introduction - Performance - Strategies - Conventional Storage Methods and Equipment - Automated Storage System - Carousel Storage System - Engineering Analysis of Storage System.	9
MANUFACTURING SYSTEMS		
IV	Components of Manufacturing System - Single Station Manufacturing Cells, Manual Assembly Lines - Automated Production Lines - Automated Assembly Systems.	9
ASSEMBLY SYSTEMS		
V	Robotic Assembly Automation - Parts Presentation Methods - Assembly Operations - Compliance and Remote Centre Compliance (RCC) Device - Adaptable Programmable Assembly System.	9
	Total Instructional Hours	45

On completion of the course the students will be able to

Course Outcome	CO1: Apply the automation principles in manufacturing systems CO2: Develop different material handing mechanisms for industriesCO3: Propose the benefits of automated storage systems CO4: Compare manual assembly lines and automated assembly lines CO5: Enumerate different assembly operations in industries

TEXT BOOKS:

Groover, M.P. "*Automation, Production Systems, and Computer - Integrated Manufacturing*", 3rd Edition, Pearson Education, 2008.

T2- C.Ray Asfahl, "Robtos and Manufacturing automation", 2nd Edition, John Wiley and Sons Ltd., New Delhi, 2011.

REFERENCE BOOKS:

R1- Groover, M.P. and Simmers, E.W. "*Computer Aided Design and Manufacturing*", Pearson Education, New Delhi, 2009.
R2- Nand K. Jha. "*Handbook of Flexible Manufacturing Systems*", Academic Press, Orlando, 2006.
R3- Groover, M.P., "*Fundamentals of Modern Manufacturing*", Pearson Education, New Delhi, 2004.
R4- Daniel E Kandray P E, "Programmable Automation", Industrial Press Publications, New Delhi, 2008.

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1. http://een.iust.ac.ir/profs/Shamaghdari/Mechatronics/Resources/3Shetly_Mechatronics%20System%20Design.
2. http://mte401.weebly.com/uploads/1/4/0/7/14075053/2hr15sep14.pdf

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	2	3	-			-	2	1	3	2	2
CO2	3	3	2	2	3	-			-	2	1	3	2	2
CO3	3	3	2	2	3	-			-	2	1	3	2	2
CO4	3	3	2	2	3	-			-	2	1	3	2	2
CO5	3	3	2	2	3	-			-	2	1	3	2	2
AVG	3	3	2	2	3	-	-	-	-	2	1	3	2	2

1-low, 2-medium, 3-high, '-"- no correlation
Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7401	Project Management	3	0	0	3

Course Objective	1. To observe how to plan and manage the projects at each stage of the Software Development Life cycles 2. To learn the successful projects that support organization's Strategic Goals 3. To acquire the knowledge about the activities necessary to successfully complete and close the Software Projects 4. To discuss the various categories of risk involved in Project Development 5. To develop the knowledge about Organizational Behavior and Team Works

Unit	**Description**	**Instructional Hours**
	SOFTWARE PROJECT MANAGEMENT	
I	Introduction - Need for Software Project Management - Activities by Software Project Management - Software Project versus Other Projects - Categories of Software Projects	9
	PROJECT EVALUATION AND PROGRAMME MANAGEMENT	
II	Project Evaluation: Introduction - Project Portfolio Management -Evaluation of Individual Projects - Cost Benefit Analysis and Evaluation Techniques. Programme Management: Managing the Allocation of Resources - Strategic Programme Management - Creating a Programme - Aids to Programme Management - Benefits Management.	9
	ACTIVITY PLANNING	
III	Objectives of Activity Planning - Project Schedules, Projects and Activities, Sequencing and Scheduling Activities, Network Planning Modes - Formulating Network Models, Identifying Critical Path, Identifying Critical Activities.	9
	RISK MANAGEMENT	
IV	Introduction – Risk and categories of risk - Framework for Dealing with Risk - Risk Identification - Risk Assessment - Risk Planning - Evaluating Risks to the Schedule - Applying the PERT Technique - Monte Carlo Simulation.	9
	PEOPLE MANAGEMENT AND TEAM ORGANIZATION	
V	Managing People: Understanding Behavior, Organizational Behavior - Selecting the Right Person for the Job - Instruction in the Best Method – Motivation based on Taylorist model - Stress - Health and Safety. Team Organization: Becoming a Team - Decision Making - Organization and Team Structures.	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Integrate organizational needs to the most effective Software Development Model CO2: Plan and manage projects at each stage of the Software Development Life Cycle CO3: Analyze between planning modules that address Real World Management Challenges CO4: Describe various types of Risk, Risk Identifications and planning involved in Project Management CO5: Applying skill of working as a team and as a decision maker in an Organization

TEXT BOOKS:

T1- Bob Hughes, Mike Cotterel, Rajib Mall, *"Software Project Management"*, 6th Edition, Tata McGraw Hill PublishingCompany Limited, New Delhi, 2017.

T2-Gopalaswamy Ramesh, *"Managing Global Software Projects"*, 1st Edition, Tata McGraw Hill Publishing CompanyLimited, New Delhi, 2005.

REFERENCE BOOKS:

R1- Dick Billows, *"Essentials of Software Project Management"*, 1st Edition, Hampton Group Inc., 2004.
R2- Donald J.Reifer, *"Software Management"*, 7th Edition, John Wiley & Sons Ltd., New Delhi, 2006.
R3- Robert K. Wysocki "*Effective Software Project Management*" – Wiley Publication, 2011.
R4- Walker Royce: "*Software Project Management*"- Addison-Wesley, 1998.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1						2	3	3	1		2	2		
CO2						2		1	2		1	3		
CO3					2	1					1			
CO4					2	2					2			
CO5						3					1	1		
AVG	-	-	-	-	0.8	2	0.6	0.8	0.6	-	1.4	1.2	-	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B. E	22MT5601	BASICS OF MECHATRONICS SYSTEM	3	0	0	3

	The student should be made	
Course Objective	1	To impart knowledge on basic measurements and its principles
	2	To apply the basic laws used in Electrical circuits and the different components
	3	To impart knowledge on construction and working of DC
	4	To provide knowledge on the fundamentals of semiconductor devices and their applications
	5	To familiarize the basic introduction of sensors &actuators

Unit	Description	Instructional Hours
I	**SCIENCE OF MEASUREMENT** Units and Standards - Calibration Techniques - Errors in Measurement – Generalized Measurement System – Voltmeter - Ammeter - Multimeter - Meter Protection	9
II	**ELECTRICAL CIRCUITS** Current - Voltage - Power - Resistor - Pullup and Pull down resistor - Ohms Law – Series and Parallel Circuit - Kirchhoff's Voltage Law - Kirchhoff's Current Law- Nodal Analysis - Mesh Analysis.	9
III	**ELECTRICAL MACHINES** Principles of operation and characteristics of DC machines - Transformers (Single and Three phase) - Synchronous machines - Three phase and Single phase Induction motors – Brushless DC Motor - Stepper Motor - Servo Motor	9
IV	**INTRODUCTION TO ELECTRONICS** Characteristics of PN Junction Diode - Zener Effect-Zener Diode and its characteristics-Halfwave and Fullwave Rectifiers-Voltage Regulation - Study of Switching devices :SCR TRIAC & IGBT.	9
V	**SENSORS &ACTUATORS** Principles – Classification of Transducers – Parameters – Criteria for Transducers selection – Resistive Transducer – Inductive Transducer – capacitive Transducer -Types of actuators– characteristics of actuators-Examples and applications	9
	Total Instructional Hours	30+15

Course Outcome	CO1	Use appropriate devices for measurement.
	CO2	Apply the KVL and KCL in electrical circuits
	CO3	Explain the constructional features of AC and DC machines.
	CO4	Identify electronics components and use of the mode sign circuits
	CO5	Construct block diagram and explain about the sensors and actuators functions.

TEXTBOOK:

T1	VN Mittle,AravindMittle, "Basic Electrical Engineering", Tata McGraw HillEdition, Second edition,NewDelhi,2009.
T2	AK Sawney, PuneetSawney,"A Course in Electrical and Electronic Measurements and Instrumentation",2nd Edition, DhanpatRai&Company,2010.

REFERENCES:

R1	Shanmugam G and Palanichamy MS," Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co.,New Delhi,3rd Edition,2010.
R2	Muthu Subramanian R,Salivahanan S and Muraleedharan KA," Basic Electrical, Electronics and Computer Engineering",Tata McGraw Hill, Second Edition,2010
R3	Musa Jouaneh and Christopher M Shott, "Fundamentals of Mechatronics", Global Engineering Publications, Second Edition, 2013.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	1	0	0	0	0	0	0	0	0	1	3	2
CO2	3	3	1	0	0	0	0	0	0	0	0	2	2	2
CO3	2	0	3	0	1	0	0	0	0	0	0	1	3	3
CO4	2	0	3	2	0	0	0	0	0	0	0	1	3	3
CO5	3	0	0	0	2	0	1	0	0	0	0	2	2	1
AVG	2.6	1	1.6	0.4	0.6	0	0.2	0	0	0	0	1.4	2.6	2.2

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B.E	22MT5203	CONCEPTS OF MACHINES AND MECHANISMS	3	0	0	3

The student should be made

Course Objective

1	Identify various links in popular mechanisms
2	Evaluate the friction forces required to hold a system in static and dynamic condition.
3	Understand the function of a flywheel and plot the various position of crank
4	Discuss the Gyroscopic couple in different conditions
5	Identify the governors of different applications

Unit	Description	Instructional Hours
I	**KINEMATIC OF MECHANISMS** Terminology and definitions of Mechanism –Planar Mechanism – Spherical Mechanism - Spatial Mechanism –Redundant Parallel Mechanism - Velocity and Acceleration Polygons for four bar mechanism	9
II	**FRICTION** Types of Friction - Law of Friction - Angle of Response - Minimum Force required to slide a body on a rough horizontal and inclined plane - Screw Friction and Screw Jack – Torque required to lift and lower the load by screw jack	9
III	**TURNING MOMENT DIAGRAM &FLYWHEELS** Turning Moment Diagram for Single Cylinder Double acting steam Engine, Four Stroke Cycle Internal Combustion Engine and Multi cylinder Engine – Fluctuation of Energy - Flywheels - Flywheels of Punching Press	9
IV	**GYROSCOPIC COUPLE** Processional Angular Motion - Gyroscopic couple - Effect of Gyroscopic couple on Aeroplane - Effect of Gyroscopic Couple on Ship - Stability of Four Wheel Drive Moving in a Curved Path - Stability of Two Wheel Vehicle Taking a turn	9
V	**GOVERNORS** Types of governors - Force Analysis of Porter and Hartnell Governors - Controlling Force - Stability – Sensitiveness – Isochronism - Effort and Power of Porter and Hartnell Governors.	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Interpret the working of different mechanism
CO2	Describe friction as a force that impedes motion.
CO3	Explain numerous factors to design an appropriate flywheel for the engine to minimize the crank speed variance during each cycle
CO4	To apply the knowledge of gyroscopic couple in engineering applications
CO5	To recognise the different types of governors and their applications

TEXT BOOK:

T1	Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
T2	Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019
T3	R S khurmi,, "Theory of Machines", 14h Edition, S Chand, 2020.

REFERENCES:

R1	Bansal R.K., "Theory of Machines", Laxmi Publications Pvt Ltd., New Delhi, 20th edition 2009.
R2	Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
R3	M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3		3						1	1		1	2	
CO2	3	2	1							1			2	
CO3	1	3	2									1	1	
CO4	1	1	2									1	1	
CO5	3	1	1									1	1	
AVG	2.2	1.4	1.8	-	-	-	-	-	0.2	0.4	-	0.8	1.4	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B.E	22MT5204	ROBOTICS IN MEDICINE	3	0	0	3

	The student should be made	
Course Objective	1	Identify and describe different types of medical robots and their potential applications.
	2	Know basic concepts in kinematics, Dynamics, and control relevant to Medical Robotics
	3	Develop the Analytical and Experimental skills necessary to Design and Implement robotic assistance for both minimally invasive surgery and Image guided interventions
	4	Be familiar with the state of the art in applied medical robotics and medical robotics research
	5	Understand the various roles that robotics can play in healthcare.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics – State of art of robotics in the field of healthcare-DICOM	9
II	**LOCALIZATION AND TRACKING** Position sensors requirements - Tracking - Mechanical linkages - Optical – Sound based - Electromagnetic - Impedance-based - In-bore MRI tracking-Video matching - Fiber optic tracking systems - Hybrid systems	9
III	**DESIGN OF MEDICAL ROBOTS** Characterization of gestures to the design of robots - Design methodologies - Technological choices - Security.	9
IV	**SURGICAL ROBOTICS** Minimally invasive surgery and robotic integration - surgical robotic sub systems - synergistic control - Control Modes - Radio surgery – Orthopedic Surgery - Urologic Surgery and Robotic Imaging -Cardiac Surgery – Neurosurgery - case studies	9
V	**ROBOTS IN REHABILITATION AND MEDICAL CARE** Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles - Assistive robots - Robots in Physiotherapy - case studies	9
	Total Instructional Hours	45

Course Outcome	CO1	Identify various medical robots and their potential applications
	CO2	Recognize the position tracking and hybrid systems.
	CO3	Apply Robotics and its concepts in Medical field
	CO4	Simulate a MIS procedure and be aware of the state of art in surgical and oncology robotics.
	CO5	Design a medical robotic system given the specific requirements for Rehabilitation and Medical care

TEXT BOOK:

T1	Achim Ernst FlorisSchweikard, "Medical Robotics", Springer, 2016.
T2	Paula Gomes, "Medical robotics Minimally invasive surgery", Wood head, 2013

REFERENCES:

R1	Jaydev P Desai, Rajni V Patel, Antoine Ferreira; Sunil Kumar Agrawal, "The Encyclopedia of Medical Robotics", World Scientific Publishing Co. Pvt. Ltd, 2019.
R2	Jocelyne Troccaz , "Medical Robotics", John Wiley & Sons Incorporated, 2013.
R3	VanjaBonzovic , "Medical Robotics", I-tech Education publishing, Austria, 2008.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1		1
CO2	1		3									1		2
CO3			2		1									2
CO4			3											3
CO5	1		1									1		1
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	-	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B. E	21MT5205	ROBOTS AND SYSTEMS IN SMART MANUFACTURING	3	0	0	3

	The student should be made	
Course Objective	1	To get a knowledge of working on Industrial robots and their load handling capacity
	2	To enlist with an application of robots in various operation
	3	To familiar with a material handling system
	4	To impart the knowledge on robotic welding
	5	To obtain the knowledge on various type of robot welding operation

Unit	Description	Instructional Hours
I	**INTRODUCTION** Types of industrial robots - Load handling capacity - general considerations in Roboticmaterialhandling-material transfer - machine loading and unloading – Robotcentred cell	8
II	**SELECTION OF ROBOTS AND OTHER APPLICATIONS** Factors influencing the choice of a robot - robot performance testing - economics ofrobotisation - Impact of robot on industry and society. Application of Robots in continuous arcwelding - Spot welding - Spray painting - robot for underwaterapplications.	9
III	**MATERIAL HANDLING** Concepts of material handling - principles and considerations in material handling systemsdesign - conventional material handling systems - industrial trucks - monorails - rail guidedvehicles - conveyor systems -cranes and hoists - advanced material handling systems -automated guided vehicle systems - automated storage and retrieval systems(ASRS)	12
IV	**ROBOTIC WELDING** Robotic welding system, Programmable and flexible control facility –Introduction-Types-FlexPendant-Lead through programming, Operating mode of robot, Jogging-Types, programming for robotic welding.	8
V	**APPLICATIONS OF ROBOTS IN WELDING AND ALLIEDPROCESSES** Application of robot in manufacturing:Robots for assembly line operation, robots for box assemble and packaging, robots for microelectronic welding andsoldering – Applications in nuclear, aerospace and ship building, case studies for simple andcomplex applications.	8
	Total Instructional Hours	45

Course Outcome	CO1	To Recognize various concepts of Industrial Robot.
	CO2	To Select the appropriate manufacturing procedure for Robots
	CO3	To Apply various manufacturing process in Robot manufacturing.
	CO4	To Learn about the Welding operation and also related to Programming
	CO5	To Produce a manufacturing plan for developing a robot

TEXTBOOK:

T1	Richard D Klafter, Thomas Achmielewski, MickaelNegin , "Robotic Engineering – AnintegratedApproach", Prentice Hall India, New Delhi, 2006.
T2	Mikell P Groover , "Automation, Production Systems, and Computer-IntegratedManufacturing", Pearson Education, New York, 2019.
T3	Pires J N, Loureiro A, Bolmsjo G, "Welding Robots: Technology, System Issues andApplication", Springer, London, 2010.

REFERENCES:

R1	Parmar R S , "Welding Processes and Technology", Khanna Publishers, New Delhi, 2nd Edition, 2013.
R2	John A. piotrowski, William T. Randolph , "Robotic welding: A Guide to Selection andApplication, Welding Division, Robotics International of SME", Publications Development, Marketing Division, 1987.
R3	YoramKoren , "Robotics for Engineers", McGraw-Hill, 1987.
R4	Mikell P Groover, Mitchel Weiss, Roger N Nagel, N.G.Odrey, AshishDutta , "IndustrialRobotics (SIE): Technology, Programming and Applications", 2nd Edition, McGraw HillEducation India Pvt Ltd, 2012.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1		1
CO2	1		3									1		2
CO3			2		1									2
CO4			3											3
CO5	1		1									1		1
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	-	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7601	PLC AND SCADA	3	0	0	3

Course Objective	1. To study the architecture, Hardware and Software wiring of programmable logic controller 2. To read the fundamentals of PLC programming instructions 3. To explain the PLC programs to perform specified discrete sequential control operations 4. To develop the knowledge in SCADA 5. To learn basic knowledge on applications of SCADA			
Unit		**Description**		**Instructional Hours**
	PROGRAMMABLE LOGIC CONTROLLERS			
I	Architecture of PLC -Principles of Operations - PLC size and Application - PLC Discrete Modules - PLC Analog Modules– I/O Specifications-Memory Types – Scan Cycle - PLC Programming Language - Fundamentals of Logics.			9
	PROGRAMMING INSTRUCTIONS			
II	Programming EXAMINE ON and EXAMINE OFF Instructions -Logical Instructions - Control Instructions - Data Manipulating Instructions - Math Instructions - PLC Ladder Diagram.			9
	TIMERS AND COUNTERS			
III	ON DELAY Timer - OFF DELAY Timer - Retentive Timer - Timer Applications - UP Counter - DOWN Counter- UP/DOWN Counter - Counter Applications - Combining Timer and Counter Functions.			9
	SCADA SYSTEMS			
IV	Introduction and Definition of SCADA - Basic Architecture of SCADA - Human Machine Interface - Master Terminal Unit - Remote Terminal Unit - SCADA Data Transfer through PLC - Communication Technologies - Communication System Components.			9
	APPLICATIONS OF SCADA			
V	Water Level Control - Material Handling Application – Stamping System — Bottle Filling System - Automatic car washing machine			9
		TotalInstructionalHours		45

	On completion of the course the students will be able to
Course Outcome	CO1: Demonstrate knowledge and understanding of PLC interfacing and programming techniques CO2: Design and describe the operation of a PLC program CO3: Applyvarious Timers and Counters based on real time applications CO4: Describes the basics of SCADA CO5: Infer and control the Industrial Process using SCADA systems

TEXT BOOKS:

T1- Frank D. Petruzella, "Programmable Logic Controllers", 3 rd Edition, Tata McGraw Hill Publishing CompanyLimited,NewDelhi, 2010.
T2- Ronald L.Kurtz, "Securing SCADA System", 1 st Edition, John Wiley & Sons, 2015.

REFERENCEBOOKS:

R1- John W.Webb and Ronald A.Reis, "Programmable Logic Controllers-Principles and Applications", 4 th Edition,PHI Learning Private Limited, NewJersey, 2003.
R2- Stenerson,"Fundamentals of Programmable Logic Controllers, Sensors and Communication", 3 rd Edition, PearsonEducation, Asia, 2005.
R3- William T. Shaw, "Cybersecurity for SCADA systems", Penn Well Books, 2006
R4- Gary Dunning, "Introduction to Programmable Logic Controllers",3rd India edition, Cengage Learning, 2007

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1	1	
CO2	1		3									1	2	
CO3			2		1								2	
CO4			3										3	
CO5	1		1									1	1	
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	1.8	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7602	**ROBOTICS AND ITS APPLICATIONS**	3	0	0	3
Course Objective	1. To outline the evolution of robots and its mecahnism 2. To describe the various elements of robot 3. To illustrate the principle of robot kinematics and control 4. To acquire knowledge about basics of robot sensors 5. To discuss the applications of robots in industries					

Unit	**Description**	**Instructional Hours**
	ROBOT BASICS	
I	Robot-Basic concepts, Need, Law, History, Anatomy, specifications. Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot.	9
	ROBOT ELEMENTS	
II	End effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.	9
	ROBOT KINEMATICS AND CONTROL	
III	Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point to point, Continuous Path Control, Robot programming	9
	ROBOT SENSORS	
IV	Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence.	9
	ROBOT APPLICATIONS	
V	Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nano robots, Future Applications.	9
	Total Instructional Hours	45

Course Outcome	On completion of the course the students will be able to CO1: list and explain the basic elements of industrial robots CO2: Analyze the robot elements and links CO3: Analyze robot kinematics and its control methods. CO4: classify the various sensors used in robots for better performance. CO5: summarize various industrial and non-industrial applications of robots.

TEXT BOOKS:

T1- Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, "Industrial Robotics Technology, Programming and Applications", Tata –McGraw Hill Pub. Co., 2008.

T2.- Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010.

REFERENCEBOOKS:

R1- Deb. S.R., *"Robotics Technology and Flexible Automation"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited,New Delhi, 2010.

R2- Klafter R.D., Chimielewski T.A., Negin M., *"Robotic Engineering - An integrated approach"*, PHI Learning PrivateLimited, New Delhi, 2003.

R3- Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "*Robotics Control Sensing, Vision and Intelligence*", Tata McGraw HillPublishing Company Limited, New Delhi, 2008.

R4- John.J.Craig, "*Introduction to Robotics: Mechanics & control*", Pearson Publication, Fourth edition, 2018.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1		1
CO2	1		3									1		2
CO3			2		1									2
CO4			3											3
CO5	1		1									1		1
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	-	1.8

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7203	ADVANCED PLC	3	0	0	3
Course Objective	1. To give an introductory knowledge about PLC and the programming languages 2. To give basic knowledge in the application of PLC 3. Gain knowledge on computer control system 4. To give adequate information in the interfaces used in DCS 5. To discuss the advances of PLC					

Unit	**Description**	**Instructional Hours**
	PROGRAMMABLE LOGIC CONTROLLER	
I	Evolution of PLC– Components of PLC– Advantages over relay logic– Architecture of PLC– Programming devices - Discrete and Analog I/O modules– Programming languages — Ladder diagram– Programming timers and counters– Design of PLC	9
	APPLICATIONS OF PLC	
II	Instructions in PLC– Program control instructions, math instructions, sequencer instructions – Use of PC as PLC– Application of PLC– Case study of bottle filling system	9
	COMPUTER CONTROLLED SYSTEMS	
III	Basic building blocks of Computer controlled systems– SCADA– data Acquisition System - supervisory Control– Direct digital Control	9
	DISTRIBUTED CONTROL SYSTEM	
IV	DCS - Architectures– Comparison– Local control unit– Process interfacing issues– Communication facilities	9
	STATE OF ART/ADVANCES	
V	PLC as Robot– PLC in Motor Speed Control- Practical Implementation of PLC and SCADA in various electrical fields-case study	9
	Total Instructional Hours	45

Course Outcome	On completion of the course the students will be able to CO1: To Know introductory knowledge about PLC and the programming languages CO2: Gain adequate knowledge about various application of PLC CO3: know the parameters of computer control systems CO4: Design various interfaces to the digital control systems CO5: summarize various advances of PLC.

TEXT BOOKS:

T1- Frank D, Petruzella, "Programmable Logic Controller" McGraw – Hill Publications, Fourth Edition, 2016.
T2.- RonaldL.Kurtz, *"Securing SCADA System"*,1st Edition,JohnWiley&Sons,2015.

REFERENCEBOOKS:

R1- Lucas, M.P., "Distributed Control System", Van Nastrand Reinhold Company, New York, 2000.
R2- Stenerson, *"Fundamentals of Programmable Logic Controllers, Sensors and Communication"*, 3rd Edition,PearsonEducation,Asia,2005
R3- Gary Dunning,"*Introduction to Programmable LogicControllers*",3rd India edition ,Cengage Learning,2007

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2						1	1	1	1	1	
CO2	1		3									1	2	
CO3			2		1								2	
CO4			3										3	
CO5	1		1									1	1	
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	1.8	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Mapping of COs with POs and PSOs														
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO-1**	**PSO-2**
CO1	1		2						1	1	1	1	1	
CO2	1		3									1	2	
CO3			2		1								2	
CO4			3										3	
CO5	1		1									1	1	
AVG	0.6	-	2.2	-	0.2	-	-	-	0.2	0.2	0.2	0.6	1.8	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B.E	22MT7205	RADIOLOGICAL EQUIPMENTS	3	0	0	3

		The student should be made
Course Objective	1	To understand the generation of X-ray and its uses in imaging
	2	To describe the principle of Computed Tomography.
	3	To know the techniques used for visualizing various sections of the body
	4	To learn the principles of different radio diagnostic equipment in Imaging
	5	To discuss the radiation therapy techniques and radiation safety.

Unit	Description	Instructional Hours
I	**MEDICAL X-RAY EQUIPMENT** Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Cathode and filament currents, Focusing cup, Thermionic emission, Electromagnetic induction, Line focus principle and the heel effect, Causes of x-ray tube failure: Electron arcing/filament burn out, Failure to warm up tube, High temp due to over exposure, x-ray tube rating charts. X-ray Image Intensifier tubes – Fluoroscopy.	9
II	**COMPUTED TOMOGRAPHY** Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors- Viewing systems- spiral CT scanning – Ultra fast CT scanners. Advantages of computed radiography over film screen radiography: Time, Image quality, Lower patient dose, Differences between conventional imaging equipment and digital imaging equipment: Image plate, Plate readers, Image characteristics, Image reconstruction techniques- back projection and iterative method.	9
III	**MAGNETIC RESONANCE IMAGING** Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system - system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), and shim coils.	9
IV	**NUCLEAR MEDICINE TECHNIQUES** Nuclear imaging – Anger scintillation camera –Nuclear tomography – single photon emission computer tomography, positron emission tomography – Recent advances .Radionuclide imaging - Bone imaging, dynamic renal function, myocardial perfusion. Non imaging techniques - Hematological measurements, Glomerular filtration rate, volume measurements, clearance measurement, whole -body counting, surface counting	9
V	**RADIATION THERAPY AND RADIATION SAFETY** Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT,- Recent Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife - radiation measuring instruments - Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.	9

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		Total Instructional Hours	**45**
On completion of the course the students will be able to			
Course Outcome	CO1	Describe the working principle of X ray machine and its application	
	CO2	Illustrate the principle computed tomography	
	CO3	Interpret the technique used for visualizing various sections of the body using magnetic resonance imaging	
	CO4	Demonstrate the applications of radio nuclide imaging.	
	CO5	Outline the methods of radiation safety.	

TEXT BOOK:	
T1	Steve Webb, "The Physics of Medical Imaging", Adam Hilger, Philadelpia, 1988
T2	Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley Liss, 2002
REFERENCES:	
R1	Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine"- Third edition Springer, 2006
R2	B.H.Brown, PV Lawford, R H Small wood, D R Hose, D C Barber, "Medical physics and Biomedical Engineering", - CRC Press, 1999
R3	Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003
R4	P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques", Paperback – Import, 2007

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	2	1	1	2									
CO2	3	2	1	1	2									
CO3	3	2	1	1	2								1	
CO4	3	2	1	1	2								1	
CO5	3	2	1	1	2									1
AVG	3	2	1	1	2								1	1

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

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Programme	Course code	Name of the course	L	T	P	C
B.E	22MT7206	BIOMATERIALS	3	0	0	3

	The student should be made	
Course Objective	1	Learn characteristics and classification of Biomaterials
	2	Understand different metals, ceramics and its nanomaterial's characteristics as biomaterials
	3	Learn polymeric materials and its combinations that could be used as a tissue replacement implants
	4	Get familiarized with the concepts of Nano Science and Technology
	5	Understand the concept of biocompatibility and the methods for biomaterials testing

Unit	Description	Instructional Hours
I	**INTRODUCTION TO BIO-MATERIALS** Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena	9
II	**METALLIC AND CERAMIC MATERIALS** Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bioceramics.	9
III	**POLYMERIC IMPLANT MATERIALS** Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.	9
IV	**TISSUE REPLACEMENT IMPLANTS** Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.	9
V	**TESTING OF BIOMATERIALS** Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization	9
	Total Instructional Hours	**45**

On completion of the course the students will be able to		
Course Outcome	CO1	Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.
	CO2	Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
	CO3	Identify significant gap required to overcome challenges and further development in

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		polymericmaterials.
	CO4	Create combinations of materials that could be used as a tissue replacement implant.
	CO5	Understand the testing standards applied for biomaterials.

TEXT BOOK:	
T1	Sujata V. Bhatt, "Biomaterials", Second Edition, Narosa Publishing House, 2005.
T2	Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, "Biomaterials: A Nano Approach", CRC Press, 2010.
T3	Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.
REFERENCES:	
R1	Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw Hill, 2003.
R2	John Enderle, Joseph D. Bronzino, Susan M.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005.
R3	Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984
R4	A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,"Woodhead Medical Textiles and Biomaterials for Healthcare", Publishing Limited 2006.
R5	D F Williams, "Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume", VCH Publishers 1992.

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1		2							1	1	1		
CO2	1		3									1		1
CO3			2		1									1
CO4			3											
CO5	1		1									1		1
AVG	1	-	2.2	-	1	-	-	-	-	1	1	1	-	1

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	1	2	1	1							2	2	1	1
CO2	1	2	1	1							2	2	1	1
CO3	1	2	1	1							2	2	1	1
CO4	1	2	1	1							2	2	1	1
CO5	1	2	1	1							2	2	1	1
AVG	1	2	1	1							2	2	1	1
1-low, 2-medium, 3-high, '-"- no correlation Note: The average value of this course to be used for program articulation matrix.														

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		THEORY COURSES				
Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	21MT7208	**ROBOT OPERATING SYSTEMS**	3	0	0	3
Course Objective	1. To introduce ROS and programming 2. To develop the Robot environment 3. To obtain the simulation robots in ROS with GAZEBO 4. To simulate robots with V-Rep 5. To understand mapping, navigation and motion planning ROS with Move-it					

Unit	**Description**	**Instructional Hours**
	ROS ESSENTIALS	
I	Introduction to ROS- Advantages and Disadvantages of ROS - ROS Framework- ROS package C++, Python – ROS computation Graph – nodes, Messages, topics, services, bags, ROS Master- ROS Community- Basic programming and Syntax overview in C++ and Python – start with ROS programming - Creating Environment - Services-Actions and Nodes- Simple Interaction with the Simulation environment	9
	BUILD YOUR OWN ROBOT ENVIRONMENT	
II	CAD Tools for Robot Modelling – ROS Packages for robot modelling – Unified Robot Description Format and Tags- Kinematics and Dynamics Library – Create URDF Model - Robot Modelling using Unified Robot Description Format (URDF),-ROS parameter server and adding real-world object representations to the simulation environment _ Create Robot description using 7 DOF: joint number, name, type and angle limits – Xacro – Rviz – viewing of 7 DOF arm – creation of wheeled robot	9
	SIMULATION ROBOTS IN ROS WITH GAZEBO	
III	Robot simulation - Gazebo –create simulation model at Gazebo- Adding colors, textures, transmission tags, 3D vision sensor to Gazebo- Moving robot joints using ROS controllers- ROS controller interacts with Gazebo, interfacing state controller, simulation of moving the robot joints – simulation of differential wheeled robot in Gazebo.	9
	ROS WITH VREP	
IV	V-REP is a multi-platform robotic simulator - Simulating the robotic arm using V-REP - Adding the ROS interface to V-REP joint - Simulating a differential wheeled robot, Adding a laser sensor , 3D vision sensor	9
	MAPPING, NAVIGATION AND MOTION PLANNINGROS WITH MOVEIT	
V	Move it Instattion - Generating the Self-Collision matrix .virtual joints, planning groups, robot poses, robot end effector - MoveIt Architecture Diagram - Trajectory from RViz GUI executing in Gazebo - Planning scene overview diagram- Collision Checking - Motion Planning, Pick and Place Behaviors using Industrial Robots with ROS Moveit – ROS with MATLAB - ROS with Industrial	9
	Total Instructional Hours	45

	On completion of the course the students will be able to
Course Outcome	CO1: Recognize the concept of ROS and programming. CO2: Evaluate various robot algorithms in ROS programming CO3: Deploy mapping, navigation and motion planning ROS with Move-it. CO4:Simulate robots in ROS with GAZEBO and V-REP CO5: Program a Robot using ROS and its tool boxes

TEXT BOOKS:

T1- Lentin Joseph, Jonathan Cacace, "Mastering ROS for Robotics Programming", Second Edition, Packt Publishing, 2018

REFERENCEBOOKS:

R1- Lentin Joseph, Aleena Johny, "Robot Operating System (ROS) for Absolute Beginners Robotics Programming Made Easy", Second Edition, Apress, 2022.

R2- Lentin Joseph, "ROS Robotics Projects", Packt publishing, 2017

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Mapping of COs with POs and PSOs														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	2	1	2	2							1	1	2	1
CO2	2	1	2	2							1	1	2	1
CO3	2	1	2	2							1	1	2	1
CO4	2	1	2	2							1	1	2	1
CO5	2	1	2	2							1	1	2	1
AVG	2	1	2	2							1	1	2	1
1-low, 2-medium, 3-high, '-"- no correlation														
Note: The average value of this course to be used for program articulation matrix.														

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	21LSZ401	General Studies for Competitive Examinations	2	1	0	3

Course Objectives:

1. To provide awareness to the students about higher education entrance exams and various types of jobs offered both in the Central and State Government.(CAT, GMAT, GRE, IBPS, IELTS, UPSC, SSC, RRB, TNPSC, GATE, IES, TNEB, AFCAT, DRDO, ISRO, INCOME TAX,LIC...)
2. To help the students to choose the area where they are interested.
3. To develop competitive skills through various types of objective tests.
4. To train them by conducting aptitude test based on verbal and quantitative skills.

Unit	Description	Instructional Hours
I	**Numerical Ability** Simplification and Approximation – Algebra – Number System- Averages – Ratio and Proportion – Partnership – Allegation or Mixture – Problem on Ages - Percentages - Profit and Loss – Time and Work – Pipes and Cisterns – Time, Speed and Distance – Problems onTrains ,Boats and Streams - Permutation and Combination- Probability- Data Interpretation- Simple Interest and Compound Interest – Geometry , Trigonometry and Mensuration – Progressions.	18
II	**Reasoning Ability** Alphanumeric series - Reasoning Analogies – Coding-Decoding – Blood Relations -Directions – Calendars –Clocks – Data Sufficiency – Deductive Reasoning - Input-Output – Order & Ranking – Seating Arrangements –Visual Reasoning – Cubes and cuboids - Critical Reasoning – Syllogism – Venn Diagram – Puzzles	10
III	**Language Competency** Reading Comprehensions – Cloze Test – Sentence Completion – Match the Columns – Error Detection – Jumbled word/Paragraphs – Vocabulary & Grammar – One Word Substitution – Idioms and Phrases – Antonyms and Synonyms – Sentence Correction – Misfit/Out of Context sentence.	10
IV	**Computer Acquaintanceship** Internet – Memory – Keyboard Shortcuts – Computer Abbreviation – Microsoft Office – Computer Hardware – Computer Software – Operating System – Networking – Computer Fundamentals /Terminologies.	3
V	**General Awareness** Geography – Culture – History – Economic Science – Scientific Research – General Policy – Awards and Honours – Books and Authors – Static GK - Current Affairs.	4
	Total Instructional Hours	45

Course Outcome:

CO1:Thinking critically and applying basic mathematics skills to interpret data, drawconclusions, and solve problems; developing proficiency in numerical reasoning;
Application of quantitative reasoning in aptitude tests.
CO2:The ability to identify and define problems/issues, recognizing their complexity, and considering alternative viewpoints and solutions to use the critical skills of observation,
analysis, evaluation.
CO3:Understanding and reasoning using concepts framed in words; Critical verbal reasoning;
Reading Comprehension; Application of verbal reasoning in aptitude tests.
CO4:Students will possess the basic understanding of computer hardware and software, utilizing web technologies, basic understanding of network principles, Keyboard Shortcuts and
various Operating System.
CO5:Students will be updated with awareness and knowledge regarding the occurrences around the world.

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REFERENCE BOOKS:

R1: Quantitative Aptitude for Competitive Examinations – Abhijith Guptha

R2: The Pearson Guide to Quantitative Aptitude - Dinesh Khattar

R3: Analytical Reasoning and Logical Reasoning- Peeyush Bharadwaj

R4: A New Approach to Reasoning - B.S. Sijwali & S. Sijwali Arihant

R5: Word Power made easy - Norman Lewis

R6: Verbal Ability & Reading Comprehension for the CAT – Arun Sharma, Meenakshi Upadhyay - Mcgraw-hill Education

R7: Computer Awareness - Arihant Publication

R8: General Knowledge and General Awareness - Arihant Manhar Pandey

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	21LSZ402	Human rights, Women rights and Gender equality	3	0	0	3

COURSE OBJECTIVES

- To sensitize the Engineering students to various aspects of Human Rights
- To make them understand the world level perspective related to Human Rights
- To identify the constitutional rights of women
- To understand the various political rights and laws related to women
- To understand the gender equality concepts

Unit	Description	Instructional Hours
I	**Introduction** Human Rights – Evolution of the concept of Human Rights - Meaning, origin and Development. Notion and Classification of Rights – Natural, Moral and Legal Rights, Civil and Political rights. Economic, Social and Cultural Rights - Theories of Human Rights - Philosophical foundations of Human Rights	9
II	**Human Rights national and international perspective** Human Rights in India – Constitutional Provisions / Guarantees – Redressal Mechanisms at National and International levels – Constitutional Remedies and Directions of state policy - Geneva Convention of 1864. Universal declaration of Human Rights, 1948. UN agencies to monitor and compliance – UNHRC (United Nations Human Rights Commission)	9
III	**CONSTITUTIONAL RIGHTS OF WOMEN IN INDIA** Indian constitution relating to women - Fundamental rights - Directive principles of state policy - right to equality - rights against exploitation, the right to constitutional remedy - University Declaration of Human Rights - Enforcement of Human Rights for Women and Children - Role of Cells and Counseling Centers - Legal AID cells, Help line, State and National level Commission	9
IV	**POLITICAL RIGHTS OF WOMEN IN INDIA AND LAWS** Political Rights of Women in India - Electoral process - women as voters - candidates and leader - pressure group, Representation of women in local self government – women in Rural and urban local bodies – Reservation of women – Laws against violence & Sexual crimes: eve teasing – rape - indecent representation of women - immoral trafficking	9
V	**GENDER EQUALITY** Gender roles: Biological vs cultural determinism – Private vs public dichotomy – Gender division of labour and asymmetric role structure Gender role socialization and formation of identity –Occupational segregation and wage discrimination – Gender stereotyping in work place – Human development indicators and gender disparity	9

COURSE OUTCOMES:

- Engineering students will have the basic knowledge of human rights
- Initiates the students to know the various national and international perspectives of human rights
- Gives an orientation on the various rights of women
- Makes them to understand the role of women in politics
- Provides a direction on gender equalities

TEXT BOOKS

1. Kapoor S.K, "Human Rights under International Law and Indian Laws", Central Agency, Allahabad 2014
2. ArunaGoel. (2004). "Violence and Protective Measures for Women Development and Empowerment". Deep & Deep, New Delhi.

REFERENCES

1. Chandra U "Human Rights" Allahabad Law Agency, Allahabad 2014
2. Upandra Baxi "The Future of Human Rights, Oxford Univeristy Press, New Delhi
3. Menonnivedita (2004). "Recovering Subversion: Feminist Politics beyond the Law". Permanent Black, Delhi.
4. Cornick, J.C. and Meyers, M.K. (2009) *Gender Equality: Transforming Family Divisions of Labor*. New York: Verso.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	21LSZ403	Indian Ethos and Human Values	3	0	0	3

Course Objective

1. To learn about Indian ethos and its importance today
2. To know about business concepts and philosophies from various perspectives.
3. To know the Indian philosophical system of knowing oneself.
4. To understand values and its significance.
5. To know ethics from western and Indian perspective.

Unit	Description	Instructional Hours
I	**INDIAN ETHOS** Indian Ethos – Models of management in Indian socio-political environment. Indian work ethos and principles of Indian Management – Goals of Life- Teachings of important Indian Spiritual leaders..	9
II	**BUSINESS CONCEPTS AND PHILOSOPHIES** Economics of giving - Western economic system. Developing and implementing gross national happiness - Sabbath economics - Islamic economics and Banking	9
III	**INDIAN PHILOSOPHICAL SYSTEM** Indian Philosophical system - Nature of mind - Personality attributes based on Gunas - Human values and five sheaths - Bagavad Gita for human perfection	9
IV	**VALUES** Meaning - Significance - Formation of values- Science and values. – Application of values in Management - Values for managers - Chanakya neethi on leadership	9
V	**ETHICS** Introduction to Greek philosophers - Perspectives on ethics - Indian constitution and Unity in diversity - Thirukural on ethics	9
	Total Instructional Hours	**45**

Course Outcome

CO1: To impart knowledge on Indian Ethos for inspirational life
CO2: To apply Business concepts and philosophies for broader perspective in society
CO3: To familiarize students about Indian philosophy system to handle life efficiently
CO4: To apply values in day to day functioning for better standard of life.
CO5: To conceptualize ethics from western and Indian perspective

TEXT BOOKS:

T1- Nandagopal.R and Ajith Sankar R.N. Indian Ethos and Values in Management, ISBN – 978-0-07-106779-9. Tata McGraw Hill Education Private Ltd, 2011.
T2-Khandelwal.N.M, Indian Ethos and Values for Managers, ISBN 978-93-5024-452-4, 3rd Edition, Himalaya Publishing House, 2011.

REFERENCE BOOKS:

R1-Management Thoughts in Thirukkural by K. Nagarajan – ANMOL Publications PVT Ltd 4374/4B Ansari Road, New Delhi 110 002. 2010
R2-Dr. Radhakrishnan Pillai, Corporate Chanakya, ISBN 978-81-8495-133-2, Jaico Publishing House, 2016
R3-Soham, LEEP (Life Empowerment and Enrichment Program), ISBN 9788175977259 Central Chinmaya Mission Trust, 2017.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech.	21LSZ404	Indian Constitution and Political System	3	0	0	3

Course Objective

OBJECTIVES:

- Teach history and philosophy of Political Science.
- Describe the Indian Constitution and fundamental rights.
- Summarize powers and functions and Emergency rule of Indian government.
- Explain Local Governance.
- Converse the challenges to Indian Democracy

Unit	Description	Instructional Hours
	INTRODUCTION	
I	Meaning, Nature and Scope of Political Science – Significance of Political Science as a Discipline - Approaches to the study of Political Science – Key Concepts: State, Nation and Sovereignty - Political Science as a Science or an Art .	9
	CONSTITUTION OF INDIA &FUNDAMENTAL RIGHTS	
II	Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India. Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy –Rights of women and Children -Constitutional Remedies for citizens	9
	PARLIAMENTARY FORM OF GOVERNMENT AND EMERGENCY PROVISIONS	9
III	The constitution powers and the status of the president in India. – Amendment of the constitutional powers and procedures – Emergency provisions: National emergency, President rule, Financial emergency.	
	LOCAL GOVERNANCE	
IV	Panchayati Raj and Municipal Government; Structure, Power & Functions; Significance of 73rd and 74th Amendments; Changes in Rural Power structure and empowerment of the marginalized groups such as SCs/STs and Women	9
	CHALLENGES TO INDIAN DEMOCRACY	
V	Caste, class, ethnicity and gender in Indian politics; Criminalization and corruption, politics of regionalism, communalism, backward class and Dalit movements, Tribal people movements, struggle for gender justice	9
	Total Instructional Hours	**45**

Course Outcome

Upon completion of the course, students will be able to
CO1: Understand the history of Indian Constitution
CO2: Understand fundamental rights and fundamental duties.
CO3: Understand the Parliamentary form of Governmentand Challenges to Indian Demorcracy

TEXT BOOKS:

T1 - Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi, 1997.
T2 -Agarwal R C., "Indian Political System",S.Chand and Company, New Delhi, 1997.
T3 - Johari,J.C. Principles of Modern Political Science. New Delhi: Sterling, 1989.
T4 - Sharma K L., "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi, 1997.

REFERENCE BOOKS:

R1 - Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
R2 - Gahai U R., "Indian Political System ", New Academic Publishing House, Jalaendhar.
R3 -Sharma R N., "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech.	21LSZ405	YOGA FOR HUMAN EXCELLENCE	3	0	0	3

OBJECTIVE:

Understanding of (1) Structure and functions of Human Body, (2) Importance of Physical Exercises and various Medical systems (3) Life-force and Philosophy of Kaya Kalpa (4) Mind and its functions and (5) Meditation Practices.

UNIT I - PHYSICAL STRUCTURE

- **Purpose of life - life – yoga – modern life style – importance of physical health**

  Physical structure – combination of five elements – three forms of body
- **Blood circulation system – Respiratory system.**
- **Nervous system - Digesting system.**

UNIT II - FUNCTIONS OF PHYSICAL BODY

- **Three circulations – disease, pain and death - causes for disease.**
- **Limit and method in five aspects – food, work, sleep, sensual pleasure and thought.**
- **Importance of physical exercises – Simplified Physical Exercises - Rules and regulations.**
- **Food and Medicine – yogic food habits – natural food – naturopathy – Medical systems: Allopathy, Siddha, Ayurvedha, Unani and Homeopathy.**

UNIT III - REJUVENATION OF LIFE-FORCE

- **Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force – Bio-Magnetism - Mind.**
- **Anti-ageing and postponing death - Kayakalpa Practical - benefits.**
- **Sex and spirituality - value of sexual vital fluid - married life – chastity.**
- **Functional Relationships of body, life force and mind.**

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UNIT IV - MIND

Bio-magnetic wave – Mind - imprinting and magnifying - Eight essential factors of living beings.

- Mental Frequency – functions of mind – five layers
- Ten stages of mind Benefits of meditation habitual imprints – understandable imprints.

Importance of meditation – benefits of meditation.

UNIT V - MEDITATION

Simplified Kundalini Yoga - greatness of guru - types of meditation

Agna meditation - explanation - benefits.

Santhi meditation - explanation - benefits - clearance of spinal cord - benefits.

- Thuriam meditation - explanation - benefits - Thuriyatheetham meditation - explanation - benefits.

Text Book:

1. Yogic Life - VISION, Vethathiri Publications.

Reference Books:

1. Vethathiri Maharishi, Yoga for Modern age, 2017, Vethathiri Publications, Erode.
2. Vethathiri Maharishi, Mind, 2017, Vethathiri Publications, Erode.
3. Dr.Mathuram Sekar, Medicine and Health, Narmadha Publications.
4. Vethathiri Maharishi, Simplified Physical Exercises, 2013, Vethathiri Publications, Erode.
5. WCSC-VISION for Wisdom, Yogasanas, 2012, Vethathiri Publications, Erode.

Mapping of COs with POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1														
CO2														
CO3														
CO4														
CO5														
AVG														

- 1-low, 2-medium, 3-high, '-"- no correlation
- Note: The average value of this course to be used for program articulation matrix.

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