Dr. Babasaheb Ambedkar Technological University, Lonere

(Established by Government of Maharashtra, vide Dr. Babasaheb Ambedkar Technological University Act. No XXIX of 2014)

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NEP 2020 BASED CURRICULUM

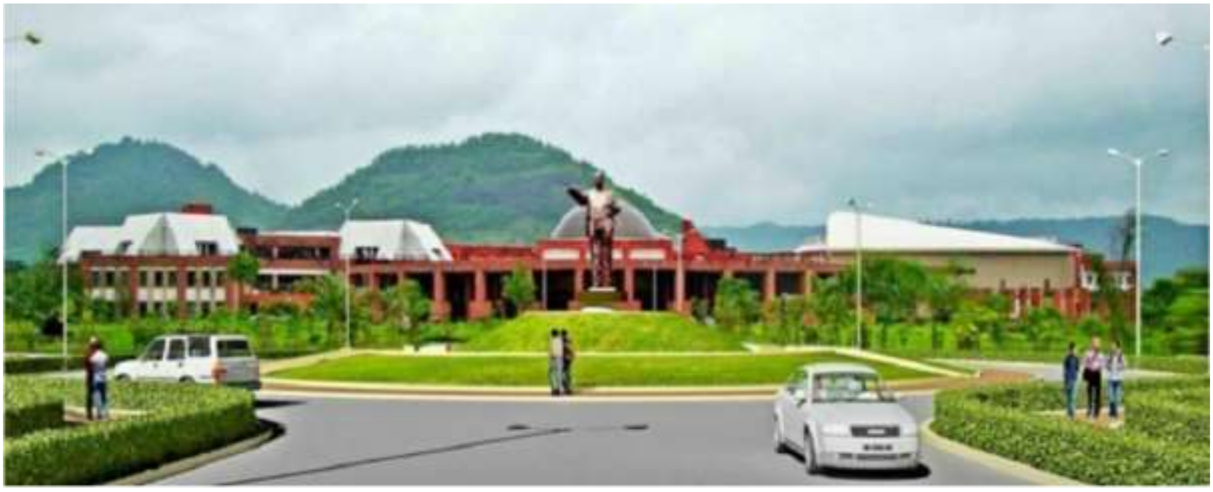
for

AFFILIATED COLLEGES

Third Year B. Tech. in

MECHANICAL AND AUTOMATION ENGINEERING

ACADEMIC YEAR 2026-2027



	Vision	Mission
University	The University is committed to become a leading 'Center of Excellence' in the field of Engineering, Technology and Science as a seat of learning with a national character and international outlook.	The University is committed to provide quality technical education, research and development services to meet the needs of industry, business, service sector and society, at large.
Department of Mechanical Engineering	The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.	Imparting quality education, looking after holistic development of students and conducting need-based research and extension.

Graduate Attributes:

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
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.
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.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
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.
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.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
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.
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.
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 Educational Objectives (PEOs):

PEO1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO2	Graduates should excel in best post-graduate engineering institutes, reaching advanced degrees in engineering and related discipline.
PEO3	Within several years from graduation, alumni should have established a successful career in an engineering-related multi-disciplinary field, leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.
PEO4	Graduates are expected to continue personal development through professional study and self-learning.
PEO5	Graduates are expected to be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes:

At the end of the program the student will be able to:

PO1	Apply knowledge of mathematics, science and engineering to analyze, design and evaluate mechanical components and systems using state-of-the-art IT tools.
PO2	Analyze problems of production engineering including manufacturing and industrial systems to formulate design requirements.
PO3	Design, implement and evaluate production systems and processes considering public health, safety, cultural, societal and environmental issues.
PO4	Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.
PO5	Apply current techniques, skills, knowledge and computer-based-methods and tools to develop production systems.
PO6	Analyze the local and global impact of modern technologies on individual organizations, society and culture.
PO7	Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.
PO8	Exhibit responsibility in professional, ethical, legal, security and social issues.
PO9	Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.
PO10	Communicate effectively in diverse groups and exhibit leadership qualities.
PO11	Apply management principles to manage projects in multidisciplinary environment.
PO12	Pursue life-long learning as a means to enhance knowledge and skills.

Credit Framework under Four-Years Under Graduate Engineering Programme with Multiple Entry and Multiple Exit options:

- The Four-year Bachelor's Multidisciplinary Engineering Degree Programme allows the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning from different institutions.
- The minimum and maximum credit structure for different levels under the Four-year Bachelor's Multidisciplinary Engineering Under-Graduate Programme with multiple entry and multiple exit options are as given below:

Credit Framework

Level	Qualification Title	Credit Requirement		Semester	Year
		Minimum	Maximum		
4.5	One-Year UG Certificate in Engg./ Tech.	40	44	2	1
5.0	Two-Years UG Diploma in Engg./Tech.	80	88	4	2
5.5	Three-Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. (Engg./ Tech.)	120	132	6	3
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech. with Multidisciplinary Minor	160	176	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech. - Honors with Research and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech. - Major Engg. Discipline with Double Minors (Multidisciplinary and Specialization Minors)	180	194	8	4

- There are multiple exit options at each level. The students will be given a specific Qualification mentioned in the table depending on the level at which he/she decides to have an exit, e.g., if a student decides to exit after completion of two years (level 5.0) of the program, he/she will be given a Diploma in Engineering with specific exit condition mentioned in the syllabus of the specific branch. He/she can rejoin the program with the multiple entry option at the level next where he/she chose to exit previously. The student can join at level 5.5 if successfully completed level 5.0 previously at the time of exit.
- Minimum credit requirements of each level are mentioned in the credit framework table.
- There are **4 distinct options available at level 6.0.**
- **First one is basic level 6.0 option** where minimum 160 - maximum 176 credits are mandatory which can be completed as per the Semester-wise Credit distribution structure mentioned in the table given below.

  Here, the Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with multidisciplinary minor (160 - 176 Credits) i.e. **B. Tech. in Mechanical Engineering with Multidisciplinary Minor** (160 - 176 credits) enables students to take up five-six or required additional courses of 14 credits in the discipline other than Mechanical Engineering distributed over semesters III to VIII. Here in the case of **B. Tech. in Mechanical Engineering with Multidisciplinary Minor** (160 - 176 credits) student is supposed to take up 50% or more Core Courses (mandatory courses, electives, vocational courses, Internship/ Field Projects/ Apprenticeship/Community Engagement Projects, Seminars, and Group Discussions) **from Mechanical Engineering discipline** to complete the 50% or more credits. In addition, the student will have to earn minimum 14 credits from the **multidisciplinary minor bucket**.
- Remaining three level 6.0 options are the advanced options where the student is given an opportunity to get extra qualification by earning some extra credits (18 - 20 extra credits). **These three options are given below:**
  1. Level 6.0: The **Bachelor's Engineering Degree with Honours** in chosen Major Engg./ Tech. Discipline i.e. in Mechanical Engineering with Honours with Multidisciplinary Minor (180 - 194 credits) enables students of Mechanical Engineering to take up five to six additional courses of 18 to 20 credits in the Mechanical Engineering discipline distributed over semesters III to VIII. The mechanism of distribution of these 18 - 20 credits over semesters III to VIII, which are over and above the 160 - 176 Credits prescribed for the duration of four years will be as prescribed by the University from time to time. The **student must have CGPA equal to or greater than 7.5 at the end of second semester to be eligible for this option**.
  2. Level 6.0: **The Bachelor's Engineering Degree with Research** in i.e., in Mechanical Engineering with Research with Multidisciplinary Minor (180 - 194 credits) enables students of Mechanical Engineering to take up a research project of 18 to 20 credits in the Mechanical Engineering discipline

distributed over the semesters VII to VIII. The **student must have CGPA equal to or greater than 7.5 at the end of sixth semester to be eligible for this option**.

3. Level 6.0: The **Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor** (Multidisciplinary Minor and Specialization Minor, 180 - 194 credits), i.e. **B. Tech. in Mechanical Engineering with Multi-disciplinary Minor and with Specialization Minor in Computer Engineering** (180 - 194 credits) enables students to take up five-six additional courses of 14 credits in the discipline other than Mechanical Engineering (for the completion of multidisciplinary minor) and 18 to 20 extra credits in the **Computer Engineering discipline** distributed over semesters III to VIII. Here, the ***other selected discipline*** **in Engineering should be different from Specialization Minor i. e. Computer Engineering**. This enables students to take up five-six or required additional courses of 18 to 20 credits in the **Computer Engineering** discipline distributed over semesters III to VIII, which are over and above the min.160 - max.176 Credits. The mechanism of distribution of these 18 - 20 credits over the semesters III to VIII, prescribed for the duration of four years will be as prescribed by the University from time to time. **The student must have CGPA equal to or greater than 7.5 at the end of second semester to be eligible for this option**.

Semester-wise Credit distribution structure for Four Year UG Engineering Program - One Major, One Minor

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	06-08	08-10		--	--	--	--	--	14-18
Engineering Science Course		10-08	06-04		--	--	--	--	--	16-12
Programme Core Course (PCC)	Program Courses	--	02	08-10	08-10	10-12	08-10	04-06	04-06	44-56
Programme Elective Course (PEC)		--	--	--	--	04	08	02	06	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses		-	02	02	04	02	02	02	14
Open Elective (OE) Other than a particular program		--	--	04	02	02	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)			02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--		04	04
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	-	-	02
Project		--	--	--	--	--	--		04	04
Internship/ OJT		--	---			--	--	12	-	12
Co-curricular Courses (CC)	Liberal Learning Courses	02	02		--	--	--	--	-	04
Total Credits (Major)		**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**160-176**

It is necessary to follow the Semester-wise Credit distribution structure for Four-year UG Engineering Program as prescribed above.

- There are seven vertical categories with specific credits distributed in specific semesters.
- Student can choose a Program Elective Course (PEC) in that specific semester from the given subjects.
- Multidisciplinary course (MDM) and Open Elective (OE) courses can be chosen from the MDM and OE Buckets depending on student's choice. Completion of total credits given in the last column of the table for each vertical is mandatory.
- The students can complete 40% of the courses through online platforms like

NPTEL/SWAYAM. The NPTEL/SWAYAM course content should be at least 80% similar to the course content in the syllabus.

General Rules and Regulations:

1. The normal duration of the course leading to B. Tech. degree will be EIGHT semesters.
2. The normal duration of the course leading to M. Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. For the First year B. Tech. and M. Tech. Classes, the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra-curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

Registration:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:
   A full-time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters: In order to facilitate proper planning of the academic activities of a semester, it is essential for every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/ PhD courses and the corresponding rules of evaluation will apply.
4. Under-Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the Departmental Under-Graduate Committee (DUGC) / Departmental Post-Graduate Committee (DPGC) is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfils the following conditions:
   i) Satisfied all the Academic Requirements to continue with the programme of Studies without termination
   ii) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
   iii) Paid all required advance payments of the Institute and hostel for the current semester;
   iv) Not been debarred from registering on any specific ground by the Institute.

Evaluation System:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2023-24, from the first year B. Tech.

Percentage of Marks	Letter Grade	Grade Point
91 - 100	EX	10.0
86 - 90	AA	9.0
81- 85	AB	8.5
76 - 80	BB	8.0
71 - 75	BC	7.5
66 - 70	CC	7.0
61 - 65	CD	6.5
56 - 60	DD	6.0
51 - 55	DE	5.5
40 - 50	EE	5.0
<40	FF	0.0

2. Class is awarded based on the CGPA of all eight semesters of B. Tech. Program.

CGPA	Class
5.00 to 5.49	Pass class
5.50 to 5.99	Second Class
6.00 to 7.49	First Class
7.5 and above	Distinction
[Percentage of Marks = (CGPA - 0.5)*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

Mid Semester Exam (MSE) Marks	20
Continuous Assessment Marks	20
End Semester Examination (ESE) Marks	60

4. A total of 100 Marks for each practical course are distributed as follows:

Continuous Assessment Marks	60
End Semester Examination (ESE) Marks	40

- It is mandatory for every student of B. Tech. to score a minimum of 40 marks out of 100, M. Tech. to score a minimum of 45 marks out of 100 with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.
- This will be implemented from the first year of B. Tech. starting from Academic Year 2023-24.

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.

EE Grade: The 'EE' grade stands for minimum passing grade.

The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.

FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance.

6. Evaluation of Performance

a. **Semester Grade Point Average (SGPA)**

The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPA is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{\left[\sum_{i=1}^{n} c_i g_i\right]}{\left[\sum_{i=1}^{n} c_i\right]}$$

where,

'n' is the number of subjects for the semester,

'c_i' is the number of credits allotted to a particular subject, and

'g_i' is the grade-points awarded to the student for the subject based on his/her performance as per the table **given in point No. 1.**

SGPA will be rounded off to the second place of decimal and recorded as such.

b. **Cumulative Grade Point Average (CGPA):**

An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (up to two decimal places). Starting from the first semester at the end of each semester (S); a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{\left[\sum_{i=1}^{m} c_i g_i\right]}{\left[\sum_{i=1}^{m} c_i\right]}$$

where,

m is the total number of subjects from the first semester onwards up to and including the semester *S*,

c_i is the number of credits allotted to a particular subject, and

g_i is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

CGPA will be rounded off to the second place of decimal and recorded as such.

7. **Attendance Requirements:**

   a. All students must attend every lecture, tutorial and practical classes.

   b. To account for approved leave of absence (e.g. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted. If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination. The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be. In any case, the student will not be permitted for appearing the examination if the attendance is less than 65%.

   c. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.

   d. The attendance records are to be maintained by the course instructor and s/he shall show it to the student, if and when required.

8. **Transfer of Credits:**

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.
b) Credits transferred will be considered for overall credits requirements of the programme.
c) Credits transfer can be considered only for the course at same level i.e. UG, PG etc.
d) A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. S/he shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to the Dean, Academics for approval.
e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.
f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.
g) In exceptional cases, the students may opt for higher credits than the prescribed.

Sem V (with effect from AY 2026-27)

Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
PCC	MTX	Thermal Engineering	2	1	-	20	20	60	100	3
PCC	MTX	Manufacturing Processes	3	-	-	20	20	60	100	3
PCC	Automation	Principles of Automation	2	1	-	20	20	60	100	3
PCC	MTX	Metrology and Quality Control	3	-	-	20	20	60	100	3
MDM		MDM**	3	-	-	20	20	60	100	3
PEC		Engineering Tribology	3	-	-	20	20	60	100	3
	MTX	Sensors for Automation								
	MTX	Product Design Engineering								
		Data Acquisition System								
	MTX	Automobile Engineering								
VSEC	MTX	Thermal Engineering Lab	-	-	2	60	-	40	100	1
		Metrology Lab	-	-	2	60	-	40	100	1
VSEC	MTX	Workshop Practice-II	-	-	2	60	-	40	100	1
VSEC		Seminar	-	-	2	60	-	40	100	1
OJT		Field /Industrial Training –I (To be started)	-	-	-	-	-	-	-	-
		Total	**16**	**2**	**8**	**360**	**120**	**520**	**1000**	**22**

MDM to be offered to other departments: Manufacturing Processes/ Fluid Mechanics

MDM** (the students will have to choose the MDM course being offered by other disciplines available/offered at the college)

Sem VI (with effect from AY 2026-27)

Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
PCC	Automation	Robotics	2	1	-	20	20	60	100	3
PCC	MTX	Mechatronics	3	-	-	20	20	60	100	3
PCC		Machine Design-I	2	1	-	20	20	60	100	3
PCC		Pneumatics and Hydraulics	3	-	-	20	20	60	100	3
MDM		MDM**	3	-	-	20	20	60	100	3
		Virtual Instrumentation	3	-	-	20	20	60	100	3
		Machine Vision System								
	MTX	PLC and SCADA								
	MTX	Control System Engineering								
VSEC	MTX	Mechatronics Lab	-	-	2	60	-	40	100	1
VSEC		Machine Design Practice	-	-	2	60	-	40	100	1
VSEC	MTX	Pneumatics and Hydraulics Lab	-	-	2	60	-	40	100	1
CEP		Technical Project Related to Community Services	-	-	2	60	-	40	100	1
OJT		Field /Industrial Training –I (To be completed)	-	-	-	-	-	-	-	-
		Total	**16**	**2**	**8**	**360**	**120**	**520**	**1000**	**22**

MDM to be offered to other departments: Theory of Machines/ Automobile Engineering

Exit Option-III: Qualifier for UG Bachelor’s Degree

A project should be carried out in the areas of Mechanical and Automation Engineering

- To be completed during vacation after third year in the industry/institute.
- This should contain the well-defined project activity which is equivalent to 12 Credits.
- It should be carried out for the duration of 12 Weeks.
- The project should be evaluated by a panel of examiners.

Course Code:
Course Title: Thermal Engineering

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Credits: 3	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End-Semester Exam: 60 Marks (Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand and conceptualize the basic concepts of thermodynamics including laws
CO2	Understand concept of heat transfer
CO3	Understand about the heat exchanger
CO4	Understand the thermal systems Boiler and compressor
CO5	Understand of vapor cycle

Mapping of course outcomes with program outcomes

Course Outcomes	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1										
CO2	1	2	1									
CO3		1	1									
CO4	2											
CO5	1	1										

Course Contents

Unit 1: Fundamental of Thermodynamics

Basics; Thermodynamic system and its type; Macroscopic vs. Microscopic viewpoint, properties, processes and cycles, point function, path function. Thermodynamic equilibrium, Quasi-static process. Zeroth law of thermodynamics and temperature and its measurement

Unit 2: First and Second Laws of Thermodynamics

First law of thermodynamics for a closed system concept of Enthalpy, PMM-I, SFEE and its application (No derivation)

Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Kelvin-Plank and Clausius statements and their equivalence, Reversibility and Irreversibility, Carnot cycle.

Unit 3: Concepts of Heat transfer

Heat transfer mechanism, conduction heat transfer, Thermal conductivity, Convection heat transfer, Radiation heat transfer, one-dimensional steady state conduction: the slab, the cylinder, composite wall, Thermal contact resistance, Electrical analogy, and Overall heat transfer

Concept of laminar and turbulent flow, Dimensional number such as Re, Nu, Pe etc, empirical correlation for pipe and tube flow, across cylinder. Free convection, Gr number, Free convection under various conditions, vertical, horizontal plate.

Unit 4: Application of Heat transfer

Heat Exchangers: Classification of heat exchangers, temperature distribution in parallel counter flow arrangement, the overall heat transfer coefficient, LMTD, the effectiveness- selection of heat exchangers.

Unit 5: Thermal Systems

Classification of boilers, boiler details, requirements of a good boiler; merits and demerits of fire tube and water tube boilers, boiler mountings and accessories, Equipment evaporation, boiler efficiency

Ideal Rankine cycle, Specific steam consumption and work ratio, Advantages and classification of steam turbines, compounding of steam turbines

Air compressor, classification, applications, reciprocating and rotary compressor, P-v diagram, volumetric efficiency

Cooling tower and its application, simple definition Range and approach.

Texts:

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill, New Delhi, 3rd edition,2005.
2. Y. A. Cengel, M. A. Boles, "Thermodynamics - An Engineering Approach", Tata McGraw Hill, 5th edition, 2006.
3. S. P. Sukhatme, "A Text book on Heat Transfer", Tata McGraw Hill Publications.

Course Code:
Course Title: Manufacturing Processes

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs /week Credits: 3	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

Course Outcomes: At the end of the course, students will be able to:

CO1	Remember the fundamental concepts of manufacturing, metal casting methods and typical casting defects.
CO2	Understand the principles and working of metal forming processes such as rolling, forging, extrusion, and drawing, along with their defects.
CO3	Select appropriate joining technique(s) for a given application
CO4	Identify turning and various hole-making operations.
CO5	Compare milling, broaching, and gear machining processes

Mapping of course outcomes with program outcomes

Course Outcomes	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1		1	1				1		1
CO2	2	2	1		1	1				1		1
CO3	2	1	1		1	1				1		1
CO4	1		1		1	1				1		1
CO5	2		1		1	1				1		1

Course Contents

Unit 1: Introduction and Casting Processes

What is manufacturing? Selection of manufacturing processes, introduction to casting, metal casting process: sand casting; shell molding; investment casting; permanent-mold casting, casting defects.

Unit 2: Metal Forming

Rolling and Forging Processes:

Introduction to rolling, flat-rolling process, defects in rolled plates and sheets, rolling mills, various rolling processes.

Introduction to forging, open-die forging, impression-die and closed-die forging, various forging operations, forging defects.

Extrusion and Drawing:

Introduction to extrusion process, hot extrusion, cold extrusion, extrusion defects. Introduction to drawing process, drawing practices, drawing defect.

Unit 3: Joining Processes

Arc welding processes: Shielded metal arc welding; MIG; TIG; submerged arc welding, Gas welding processes: oxy-fuel-gas welding; advanced welding methods: electron beam welding; laser beam welding; Other joining processes: brazing; soldering and mechanical fastening.

Unit 4: Machining Processes: Turning and Hole Making

Introduction to turning process, lathes and lathe operations, lathe components, types of lathes. Hole making operations: Boring, drilling, reaming, and tapping.

Unit 5: Machining Processes: Milling, Broaching and Gear Manufacturing

Introduction to milling and milling machines, milling cutters, broaching and broaching machines, gear manufacturing by machining: form cutting, gear generating.

Texts:

1. Serope KalpakJian and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6th edition, 2009.

References:

1. Milkell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.
2. Paul DeGarmo, J.T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing", Wiley, 10th edition, 2007.

Course Code:
Course Title: Principles of Automation

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand the need of automation
CO2	Classify various types of automated transmission lines and components of automation.
CO3	List and understand various material handling systems.
CO4	Design various types of automated assembly systems
CO5	Explain various automatic inspection systems
CO6	Develop simple automation programs using PLCs

Mapping of course outcomes with program outcomes

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

Course Contents

Unit 1: Introduction

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break- Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in process.

Unit 2: Detroit-Type Automation

Automated Flow lines, Methods of Work-part Transport, Transfer Mechanism, Buffer Storage, Control Functions, and Automation for Machining Operations, Design and Fabrication Considerations.

Analysis of Automated Flow Lines: General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines.

Unit 3: Material handling and Identification Technologies

The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems , Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing. Product identification system: Barcode, RFID etc.

Automated Assembly Systems: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multistation Assembly Machines, Analysis of a Single Station Assembly Machine.

Unit 4: Control Technologies in Automation

Industrial Control Systems, Process Industries Verses Discrete- Manufacturing Industries, Continuous Verses Discrete Control, Computer Process Control and its Forms. Computer Based Industrial Control: Introduction & Automatic Process Control, Building Blocks of Automation System: LAN, Analog & Digital I/O Modules.

Programmable Logic Controllers (PLCs)

Introduction, Micro PLC, programming a PLC, Logic Functions, Input & Output Modules, PLC Processors, PLC Instructions, Documenting a PLC System, Timer & Counter Instructions, Comparison & Data Handling Instructions, Sequencing Instructions, Mask Data Representation, Typical PLC Programming Exercises for Industrial Applications.

Unit 5: Automated Inspection and Testing

Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods.

Texts:

1. “Automation, Production Systems and Computer Integrated Manufacturing”- M.P. Grover, Pearson Education.

References:

1. “Computer Based Industrial Control” – Krishna Kant, EEE-PHI.
2. Principles and Applications of PLC – Webb John, McMillan 1992.
3. “An Introduction to Automated Process Planning Systems” – Tiess Chiu Chang & Richard A. Wysk.
4. “Anatomy of Automation” – Amber G.H & P.S. Amber, Prentice Hall.

Course Code:
Course Title: Metrology and Quality Control

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify techniques to minimize the errors in measurement
CO2	Identify methods and devices for measurement of length, angle, and gear and thread parameters, surface roughness and geometric features of parts.
CO3	Choose limits for plug and ring gauges.
CO4	Explain methods of measurement in modern machineries
CO5	Select quality control techniques and its applications
CO6	Plot quality control charts and suggest measures to improve the quality of product and reduce cost using Statistical tools.

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3								2
CO2		2	2		2							
CO3			2	3	2							
CO4						3						
CO5	1					2		3	3		3	2
CO6	1					2		3	3		2	2

Course Contents

Unit 1: Measurement Standard and Comparators

Introduction to Metrology, Importance and Scope, Measurement Standard, Line, end and wavelength, Traceability of Standards, Calibration of Instruments. Types and Sources of error, Linear measurement (Vernier Calipers, Micrometers, slip gauges) and Angular Measurement (Bevel Protector, Sine bar, Sine center). Comparators: Mechanical, Pneumatic, and Electrical (LVDT).

Unit 2: Interferometry, Surface Finish and Limits, Fits, Tolerances

Principles of interference, Concept of flatness, Flatness testing, Optical flats.

Optical Interferometer and Laser interferometer.

Surface Finish Measurement: Surface Texture, Measuring Surface Finish by Stylus probe, Tomlinson and Talysurf, Analysis of Surface Traces.

Design of Gauges: Types of Gauges, Limits, Fits, Tolerance; Terminology for limits and Fits. Indian Standard (IS 919-1963) Taylor’s Principle.

Unit 3: Metrology of Screw Thread and Gear

Screw Thread measurement: Two wire and three wire methods, Floating carriage micrometer Gear Metrology: Gear error, Gear measurement, Gear Tooth Vernier, gear rolling tester Advancements in Metrology: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology.

Unit 4: Introduction to Quality and Quality Tools

Quality Statements, Cost of Quality and Value of Quality, Quality of Design, Quality of Conformance, Quality of Performance, Seven Quality Tools: Check sheet, Flow chart, Pareto analysis, cause and effect diagram, scatter diagram, Brainstorming, Quality circles.

Unit 5: Total Quality Management and Statistical Quality Control

Quality Function Deployment, 5S, Kaizan, Kanban, JIT, Poka yoke, TPM, FMECA, FTA, Zero defects. **Statistical Quality Control:** statistical concept, Frequency diagram, Concept of Variance analysis, Control chart for variable & attribute, Process Capability. Acceptance Sampling: Sampling Inspection, sampling methods.

Introduction to ISO 9000: Definition and aims of standardizations, Techniques of standardization, Codification system.

Texts:

1. I. C. Gupta, “Engineering Metrology”, Dhanpatand Rai Publications, New Delhi, India.
2. M. S. Mahajan, “Statistical Quality Control”, Dhanpat and Rai Publications.

References:

1. R. K. Jain, “Engineering Metrology”, Khanna Publications, 17th edition, 1975.
2. K. J. Hume, “Engineering Metrology”, McDonald Publications, 1st edition, 1950.
3. A. W. Judge, “Engineering Precision Measurements”, Chapman and Hall, London, 1957.
4. K. L. Narayana, “Engineering Metrology”, Scitech Publications, 2nd edition.
5. J. F. Galyer, C. R. Shotbolt, “Metrology for Engineers”, Little-hampton Book Services Ltd., 5th edition, 1969.
6. V. A. Kulkarni, A. K. Bewoor, “Metrology & Measurements”, Tata McGraw Hill Co. Ltd., 1st edition, 2009.
7. Amitava Mitra, “Fundamental of Quality Control and Improvement”, Wiley Publication.
8. V. A. Kulkarni, A. K. Bewoor, “Quality Control”, Wiley India Publication.
9. Richard S. Figliola, D. E. Beasley, “Theory and Design for Mechanical Measurements”, Wiley India Publication.
10. E. L. Grant, “Statistical Quality Control”, Tata McGraw Hill Publications.
11. J. M. Juran, “Quality Planning and Analysis”, Tata McGraw Hill Publications.

Course Code:
Course Title: Engineering Tribology

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand basic concepts of tribology and surface interactions
CO2	Analyze friction mechanisms and influencing factors
CO3	Apply lubrication principles in engineering systems
CO4	Analyze wear mechanisms and evaluate material performance
CO5	Apply tribological design principles for material and bearing selection

Mapping of course outcomes with program outcomes

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

Course Contents

Unit 1: Introduction

Definition of tribology, friction, wear and lubrication; importance of the tribological studies. Surface Topography: Methods of assessment, measurement of surface roughness- different statistical parameters (R_a, R_z, R_{max}, etc.), contact between surfaces, deformation between single and multiple asperity contact, contact theories involved

Unit 2: Friction

Coulomb and Amontons laws of friction, its applicability and limitations, comparison between static, rolling and kinetic friction, friction theories, mechanical interlocking, molecular attraction, electrostatic forces and welding, shearing and ploughing, models for asperity deformation.

Unit 3: Lubrication

Types of lubrication, viscosity, characteristics of fluids as lubricant, hydrodynamic lubrication, Reynold's equation, elasto-hydrodynamic lubrication: partial and mixed, boundary lubrication, various additives, solid lubrication.

Unit 4: Wear

Sliding wear: Abrasion, adhesion and galling, testing methods pin-on-disc, block-on-ring, etc., theory of sliding wear, un-lubricated wear of metals, lubricated wear of metals, fretting wear of metals, wear of ceramics and polymers. Wearing by plastic deformation and brittle fracture. Wear by hard particles: Two-body abrasive wear, three-body abrasive wear, erosion, effects of hardness shape and size of particles.

Unit 5: Tribological Design and Bearing Materials

Wear rate estimation, System approach in tribodesign, reducing wear (operating parameters), Material selection and surface engineering, Bearings: Rolling bearings, Fluid film bearings, Dry and marginally lubricated bearings, Gas bearings

Texts:

1. I. M. Hutchings, “Tribology, Friction and Wear Engineering Materials”, Edward Arnold, London.
2. R. C. Gunther, “Lubrication”, Baily Brothers and Swinfen Limited.
3. F. T. Barwell, “Bearing Systems, Principles and Practice”, Oxford University Press.

References:

1. B. C. Majumdar, “Introduction to Tribology of Bearings”, A. H. Wheeler & Co. Private Limited, Allahabad.
2. D. F. Dudley, “Theory and Practice of Lubrication for Engineers”, John Willey and Sons.
3. J. Halling, “Principles of Tribology”, McMillan Press Limited. 124
4. Cameron Alas Tair, “Basic Lubrication Theory”, Wiley Eastern Limited.
5. M. J. Neale, “Tribology Hand book”, Butterworth’s. 6. D. D. Fuller, “Lubrication”.

Course Code:
Course Title: Sensors for Automation

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration:3 hrs)

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand the importance and need of sensors
CO2	Classify sensors based on different criterion
CO3	Know about the different sensor and its applications.
CO4	Apply knowledge of sensors in manufacturing process and condition monitoring

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											1
CO2	2											1
CO3	2											1
CO4	2		1	1						1		1

Course Contents

Unit 1
Introduction-role of sensors in manufacturing automation; Principles of different sensors, electrical, optical, acoustic, pneumatic, magnetic, electro-optical and vision sensors.

Unit 2
Condition monitoring of manufacturing systems: principles, sensors for monitoring force, vibration and noise.

Unit 3
Selection of sensors and monitoring techniques, acoustic emission: principles and applications, concepts of pattern recognition.

Unit 4
Sensors for CNC machine tools: linear and angular position and velocity sensors, Automatic identification techniques for shop floor control.

Unit 5
Bar code scanners, radio frequency systems, optical character and machine vision sensors, smart/intelligent sensors, integrated sensors, adaptive control of machine tools.

Texts /References:

1. D. M. Considiene, G. D. Considine, Standard Handbook of Industrial Automation, Chapman and Hall, 1975.
2. Tool and Manufacturing Engineers Handbook, Tata McGraw-Hill, SME, Vol. I, II, III, IV, 1985.
3. S. D.Murphy , In-process Measurement and Control, Marcel Dekker, 1983.
4. S. Soloman, Sensors and Control systems in Manufacturing, McGraw Hill International Editions, USA, 1987.
5. N. Zuech, Applying Machine Vision, Wiley International, 1991.

Course Code:
Course Title: Product Design Engineering

Teaching Scheme:	Examination Scheme:
Lectures: 3 hrs /week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Content

Unit 1: Introduction to Engineering Product Design

Trigger for Product/Process/System, Problem solving approach for Product Design, Disassembling existing product(s) and understanding relationship of components with each other, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept.

Unit 2: Ideation & Conceptualization

Generation of ideas, funneling of ideas, short-listing of ideas for product(s) as an individual or group of individuals, Market research for need, competitions, Product architecture, designing of components, Drawing of parts and synthesis of a product from its component parts, 3-D visualization.

Unit 3: Testing and Evaluation Prototyping

Design Automation, Prototype testing and evaluation, working in multidisciplinary teams, Feedback to design processes, Process safety and materials, Health and hazard of process operations.

Unit 4: Manufacturing

Design models and digital tools, Decision models, Prepare documents for manufacturing in standard format, Materials and safety data sheet, Final Product specifications sheet, Detail Engineering Drawings (CAD/CAM programming), Manufacturing for scale, Design/identification of manufacturing processes

Unit 5: Environmental Concerns

Product life-cycle management, Recycling and reuse of products, Disposal of product and waste. Case studies.

References:

1. Model Curriculum for "Product Design Engineer – Mechanical", NASSCOM (Ref. ID: SSC/Q4201, Version 1.0, NSQF Level: 7)
2. Eppinger, S., & Ulrich, K. (2015). Product design and development. McGraw-Hill Higher Education.
3. Green, W., & Jordan, P. W. (Eds.). (1999).Human factors in product design: current practice and future trends. CRC Press.
4. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design. McGraw-Hill book company.
5. Roozenburg, N. F., & Eekels, J. (1995). Product design: fundamentals and methods (Vol. 2). John Wiley & Sons Inc.
6. Lidwell, W., Holden, K., & Butler, J. (2010). Universal principles of designs, revised and updated: 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design. Rockport Pub.

Course Code:
Course Title: Data Acquisition System

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 03 Hrs.)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to**:**

CO1	Differentiate between single and multichannel Data Acquisition System
CO2	Describe the functional blocks of data acquisition system.
CO3	Operation of different DACs, ADCs and non-linear ADCs.
CO4	Understand data convertor and their applications
CO5	Understand interfacing of ADC and DAC with microprocessor

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO12
CO1	1	2								2		
CO2			1					2			2	
CO3	1			3		2			2			3
CO4	1		1						2			
CO5	1			3		2			1			3

Course Contents

Unit 1: Introduction
Objective of a Data Acquisition System, single channel Data Acquisition System, Multi-channel Data Acquisition System, Components used in Data Acquisition System, Converter characteristics, resolution, Non-linearity, settling time, Monotonicity.

Unit 2: Analog to Digital Converters
Classification of A/D converters, Parallel feedback, successive approximation, Ramp comparison, Dual slope integration, voltage to frequency, voltage to time logarithmic type of voltage to time logarithmic types of ADCS.

Unit 3: Non-linear data converters (NDC)

Basic NDC configurations –Some common NDACS and NADCS –Programmable non-linear ADCS, NADC using optimal sized ROM, High- speed hybrid NADC, PLS based NADC, Switched capacitor NDCS. ADC applications: Data Acquisition systems, Digital signal processing systems, PCM voice communication systems, test and measurement instruments, electronic weighing machines.

Unit 4: **Digital to Analog Converters (DACS)**

Principles and design of –Parallel R–2R, weighted resistor, inverted ladder, D/A decoding –Codes other than ordinary binary

Unit 5: **Data Converter Applications**

DAC applications, digitally programmable V/I source, Arbitrary waveform generators, digitally programmable gain amplifiers, Analog multipliers/ dividers, Analog delay lines, interfacing of DACS and ADCS to a microprocessor.

Texts/ References:

1. Electronic data converters fundamentals and applications –Dinesh K. Anvekar, B.S. Sonde –Tata McGraw Hill.
2. D/A and A/D converters a user‟s handbook of -E.R. Hnateck, Wiley3.Data converters by G.B.Clayton.
3. Electronic Analog/ Digital conversions –Hermann Schmid –Tata McGraw Hill.
4. Electronic instrumentation by HS Kalsi .

Course Code:
Course Title: Automobile Engineering

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 03 Hrs.)

Pre-Requisites: Basic knowledge of Thermodynamics (IC Engines), Fundamentals of Strength of Materials, Basics of Engineering Mechanics, Introductory knowledge of Machine Design and Manufacturing.

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand vehicle construction, classification and performance parameters
CO2	Analyze steering and suspension systems and identify faults
CO3	Explain transmission and power flow in automobiles
CO4	Evaluate braking system, tyres and vehicle safety aspects
CO5	Analyze electrical systems and diagnose faults
CO6	Apply knowledge of testing, maintenance and emission control

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									1
CO2	3	3	2	1	1							1
CO3	3	2	2	1	1							1
CO4	3	2	2	1	1	2	1					1
CO5	3	3	1	2	2							2
CO6	3	3	2	2	2	2	3	1	1	1	1	2

Course Contents

Unit 1: Introduction
Vehicle specifications, Classifications, Chassis layout, Frame, Main components of automobile and articulated vehicles; Engine-cylinder arrangements, Power requirements, Tractive efforts and vehicle performance curves.

Unit 2: Steering and Suspension Systems
Steering system; Principle of steering, Centre point steering, Steering linkages, Steering geometry and wheel alignment, power steering. Suspension system: its need and types, Independent suspension, coil and leaf springs, Suspension systems for multi-axle vehicles, troubleshooting and remedies.

Unit 3: Transmission System
Clutch: its need and types, Gearboxes: Types of gear transmission, Shift mechanisms, Over running clutch, Fluid coupling and torque converters, Transmission universal joint, Propeller shaft, Front and rear axles types, Stub axles, Differential and its types, Four-wheel drive.

Unit 4: Brakes, Wheels and Tyres

Brake: its need and types: Mechanical, hydraulic and pneumatic brakes, Disc and drum type: their relative merits, Brake adjustments and defects, Power brakes, Wheels and Tyres: their types; Tyre construction and specification; Tyre wear and causes; Wheel balancing.

Unit 5: Electrical Systems, Vehicle Testing and Maintenance

Battery: construction, operation, maintenance, Charging system, cutout and regulators, Starter motor, Bendix drive, solenoid drive, Ignition systems and ignition timing, Vehicle testing: need, standards and types, Maintenance: troubleshooting, servicing, overhauling, engine tune-up, Tools and equipment, Emissions, pollution control systems and regulations

Texts:

1. Kripal Singh, “Automobile Engineering”, Vol. I and II, Standard Publishers.
2. G. B. S. Narang, “Automobile Engineering”, Dhanpat Rai and Sons.

References:

1. Joseph Heitner, “Automotive Mechanics”, East-West Press.
2. W. H. Crouse, “Automobile Mechanics”, Tata McGraw Hill Publishing Co.

Course Code:
Course Title: Thermal Engineering Lab

Teaching Scheme:	Examination Scheme:
Practical: 2 hrs/week Credit: 1	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks (Duration 3 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

List of Experiments:

1. Calibration of thermometer and validity of Zeroth law of thermodynamics.
2. Validation of the Kelvin Planck Statement/Celsius Statement through simple programmes or using EES or any open software or students may write a computer program in any language C/C++ /FORTRAN.
3. Determination of thermal conductivity of the metal road.
4. Determination of free convection heat transfer coefficient.
5. Determination of LMTD of Parallel and counter flow HX.
6. Determination of volumetric efficiency of the reciprocating compressor.
7. Study of Boiler Mountings and Accessories through physical models.
8. Determination of the Rankine cycle efficiency and work ratio using computer programming/software.

Course Code:
Course Title: Metrology Lab

Teaching Scheme:	Examination Scheme:
Practical: 2 hrs./week Credit:1	Continuous Assessment: 60 Marks Practical/ Oral: 40 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	Measure linear, angular circular features, dimensional and geometric features
CO2	Measure surface roughness of components
CO3	Calibration of metrological equipment

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	3	1							2
CO2			2	2		1		1				2
CO3			3	2		1						2

Course Contents

List of Practicals/ Experiments

[A] Any Four from experiment No. 1 to 5 and Any Four from experiment No. 6 to 10

1. Determination of linear and angular dimensions of given composite part using precision/non-precision measuring instruments.
2. Error determination with linear / angular measuring instruments.
3. Calibration of measuring instrument. Example– Dial gauge, Micrometer, Vernier (any one)
4. Verification of dimensions & geometry of given components using Mechanical & Pneumatic comparator.
5. Machine tool alignment testing on any two machines.
6. Identification of surfaces using optical flat/interferometers and measure surface roughness using surface roughness tester.
7. Determination of geometry & dimensions of given composite object using profile projector and measurement of various angles of single point cutting tool using tool maker’s microscope.
8. Measurement of thread parameters using floating carriage diameter measuring machine.
9. Measurement of spur gear parameters using Gear Tooth Vernier, Span, Gear Rolling Tester.
10. Determination of given geometry using coordinate measuring machine (CMM).

[B] Statistical Quality Control (SQC) (Any Two) Note - Use of computational tools are recommended

1. Analyze the fault in given batch of specimens by using seven quality control tools for engineering application.
2. Determination of process capability from given components and plot variable control chart/ attribute chart.
3. Case study on various tools in Total Quality Management (TQM).

[C] Industrial visit to Calibration lab / Quality control lab / Gear manufacturing unit /Automotive Industry / Engineering Industry.

Course Code:
Course Title: Workshop Practices - II

Practical Scheme	Examination Scheme
Practical: 2 hrs./ week Credit: 1	Continuous Assessment: 60 Marks Practical/Oral Exam: 40 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents

1. **Welding Practice *(Any three)***
   a. One Job on TIG Welding.
   b. One Job on MIG Welding.
   c. One Job on Stainless Steel Welding
   d. One Job on Aluminum Welding
   e. Job on Plasma Arc Cutting
   f. Job on Submerged Arc Welding.
   g. Job on Soldering
   h. Job on Brazing

2. **Lathe Operations *(Compulsory)***
   a. Jobs involving Facing, Step Turning, Taper Turning, Knurling & 'V' Threading Operations.

References:

1. Hajra Choudhary, Element of Workshop Technology Vol. II, Media promoters and Publications, 8^{th} edition, 1992.
2. Hajra Choudhary, Element of Workshop Technology Vol. 1, Media promoters and Publications, 8^{th} edition, 1992.
3. Raghuvansrii, Workshop Technology, Vol. II, Dhanpat Rai, 9^{th} Edition, 2006
4. WA. J. Chapman, Workshop Technology, Part II, Oxford and IBH publishing Co., 4^{th} Edition, 1986.

Course Code:
Course Title: B. Tech Seminar

Teaching Scheme	Examination Scheme
Practical: 2 hrs./week Credit: 1	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												

Objectives:

- Develop the ability to identify and study recent developments in Mechanical Engineering.
- Enhance technical literature survey and research skills.
- Improve technical report writing and documentation skills.
- Develop professional presentation and communication skills.
- Understand research ethics, plagiarism, and proper referencing techniques.

<u>Guidelines for Students</u>

Seminar Topic:

- Select a recent and emerging topic in Mechanical Engineering.
- Obtain approval of the seminar topic from the Faculty Guide.
- The topic should be based on recent research, technological developments, or industrial applications.

Literature Survey:

- Conduct an extensive literature survey using journals, conference papers, books, patents, and standards.
- Review and analyze recent research work critically.

- Identify research gaps and future scope.
- Use authentic sources such as IEEE, Springer, Elsevier, ASME, SAE, ASTM, etc.

Seminar Report:

- Report should preferably contain **30–50 pages**.
- Use **Letter Size (8.5" × 11")** paper.
- Use **Times New Roman**, **12 pt** font.
- Maintain **1.5 line spacing**.
- Use **SI Units** throughout the report.
- Follow either **British English** or **American English** consistently.

Report Format:

- Title Page
- Certificate
- Acknowledgement (Optional)
- Abstract (200–300 words) with Keywords
- Table of Contents
- List of Figures and Tables
- List of Symbols (if applicable)
- Introduction
- Literature Review
- Discussion and Analysis
- Conclusion
- References
- Appendix (Optional)

Formatting Guidelines:

- Left Margin: **3.75 cm**
- Top, Bottom and Right Margins: **2.5 cm**
- Chapter titles: **14 pt, Bold**
- Figures should have captions below the figure.
- Tables should have titles above the table.
- Number all figures, tables, and equations appropriately.

References:

- Follow **IEEE** or **Author–Date** referencing style.
- Include complete bibliographic details for every reference.
- Cite all borrowed figures, tables, and information properly.

Plagiarism and Ethics:

- Prepare the report in your own words.
- Properly acknowledge all sources.
- Maintain plagiarism within the permissible institute limit.
- Follow ethical practices in technical writing.

Seminar Presentation:

- Presentation Duration: **15–20 minutes**
- Viva-Voce: **10 minutes**
- Prepare a professional PowerPoint presentation.
- Demonstrate clear understanding of the selected topic..

Submission Requirements:

- Submit the final seminar report after incorporating all corrections suggested by the Guide.
- Obtain signatures of the **Faculty Guide** and **Head of the Department** before the seminar examination.
- Submit:
    - Soft copy (PDF)
    - Printed report (Soft Bound)
    - PowerPoint presentation
    - Plagiarism report (if applicable)

Evaluation Criteria:

- Topic Selection and Literature Survey
- Technical Content and Analysis
- Report Quality and Documentation
- Presentation Skills
- Viva-Voce and Technical Discussion

Course Code:
Course Title: Field /Industrial Training – I (To be started)

Teaching Scheme	Examination Scheme
Credits: --	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: --

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

The students should identify a relevant industry in consultation with the allocated guide in the college and undertake the one-month industrial training with an objective to understand the industrial processes, tools, equipment, safety rules etc.

Course Code:
Course Title: Robotics

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs /week Tutorial: 1 hrs /week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	List the various components of a typical Robot, grippers, sensors, drive system and describe their functions
CO2	Calculate the word to joint and joint to word coordinates using forward and reverse transformations
CO3	Calculate the gripper forces, drive sizes, etc.
CO4	Develop simple robot program for tasks such as pick and place, arc welding, etc. using some robotic language such as VAL-II, AL, AML, RAIL, RPL, VAL
CO5	Evaluate the application of robots in applications such as Material Handling, process operations and Assembly and inspection
CO6	Discuss the implementation issues and social aspects of robotics

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents

Unit 1: Introduction
Various basic components of a Robotic system, various configurations, work envelopes, Manipulators, sensors, controllers, etc.

Unit 2: Mechanical System in Robotics
Motion conversion, Kinematic chains, position analysis, forward and backward transformations, natural and joints pace coordinates.

Unit 3: Drives for Robot
Electrical drives**,** Stepper motor, DC motors, AC motors, hydraulic and pneumatic drives, hybrid drives, drive selection for robotics joints.

Unit 4: Sensors in Robotics
Position sensor, velocity sensor, proximity sensors, touch sensors, force sensors, etc.

Unit 5: Robot Programming and its Application
Path planning, lead through (manual and powered) programming, teach pendant mode, programming languages, AL, AML, RAIL, RPL, VAL, VAL – II.

Artificial Intelligence for Robots: Knowledge Representation, Problem representation and problem solving, search techniques in problem solving

Applications: Application of robot in: Material handling, assembly and inspection, process operations, etc.

Texts

1. M. P. Grover, "Industrial Robotics: Technology, Programming and Applications", Tata McGraw Hill Publication.

References

1. Saeed B. Niku, "Introduction to Robotics, Analysis, Systems, Applications", Pearson Education.
2. Richard D. Klafter, "Robotic Engineering: An Integrated Approach", Prentice Hall of India.

Course Code:
Course Title: Mechatronics

Teaching Scheme:	Examination Scheme:
Lectures: 2 hrs/week Credits: 3	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit 1: Introduction
Introduction to Mechatronic systems, elements, advantages; practical examples of Mechatronic systems.
Sensors and Transducers: Various types of sensors and transducers used in Mechatronic system such as pressure sensors, temperature sensors, velocity sensors, Acceleration sensors, proximity sensors, position sensors, force sensors, Optical encoders, Capacitive level sensor, tactile sensors, Selection of sensors.

Unit 2: Signal Conditioning and Data Representation
Types of electronic signals, Need for signal processing, Operational amplifiers: Types, classification and applications, Opto-isolators, Protection devices, Analogue to Digital and Digital to Analog Converters, Interfacing devices, Electro-magnetic Relays.
Data representation systems, Displays, Seven segment displays, LCD displays, Printers, Data loggers, Data Acquisition Cards/Systems

Unit 3: Drives
Electrical Drives: Types of Electrical Motors, AC and DC motors, DC servomotors, Stepper motors, linear motors, etc.

Pneumatics and Hydraulics: Components of Pneumatic systems, actuators, direction control valves, pneumatic air preparation, FRL unit, methods of actuation of valves, Sequencing of Pneumatic cylinders using Cascade and shift register methods. Electropneumatic valves, Electropneumatic circuits using single and double solenoid methods. Hydraulic cylinders, design of cylinder, Design of Piston and piston rod, Valves, poppet valve, house pipes and design of tubing, Meter-in and Meter-out circuits.

Unit 4: Microprocessor and Microcontroller

8085 Microprocessor: architecture, various types of registers and their functions in 8085µP, Instruction sets, interfacing, applications.

8081 Microcontroller: architecture, Instruction sets, various pins and their functions interfacing, applications.

Programmable Logic Controller: Introduction, Architecture, Types of inputs/outputs, Specifications, guidelines for Selection of PLCs, Programming: Ladder logic and FBD

Unit 5: Control Systems

Open and closed loop system; block diagram manipulation/reduction, Transfer function, modeling of Mechanical Systems using Spring, Dashpot and Mass equivalence.

Stability of Systems: On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers, Introduction to control using state variable system models, Bode Plots and stability criteria.

Texts:

1. HMT Limited, “Mechatronics”, Tata McGraw Hill Publications, 1998.
2. W. Bolton, “Mechatronics; Electronic Control System in Mechanical Engineering”, Pearson Education Asia, 1999.
3. Raven, “Automatic Control Engineering”, Tata McGraw Hill Publications, New York, 1986.

References:

1. R. K. Rajput, “A textbook of Mechatronics”, S. Chand and Co., 2007.
2. Michael B. Histand, David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, Tata McGraw Hill International Editions, 2000.
3. D. A. Bradley, D. Dawson, N. C. Buru, A. J. Loader, “Mechatronics”, Chapman and Hall, 1993.

Course Code:
Course Title: Machine Design - I

Teaching Scheme:	**Examination Scheme:**
Lectures: 2 hrs/week Tutorial: 1 hr/week Credit: 3	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit 1: Introduction to Mechanical Design & Design Against Static Loads
Mechanical Engineering Design: Definition, Meaning, Importance, Phases of Design: Traditional vs. Industrial Design Process, Design Considerations: Aesthetic, Ergonomic, Standardization, Preferred Numbers, Use of Design Data Book and ISO 9000, Selection of Materials, Stresses and Strain: Axial, Bending, and Torsion, Introduction to Concurrent Engineering and Integrated Design
Static Loading: Design of Cotter Joint, Knuckle Joint and Members subjected to Eccentric loading.

Unit 2: Design Against Fluctuating Loads & Theories of Failure
Types of Loading: Static vs Fluctuating, Stress Concentration: Causes, Factors & Reduction, Endurance Limit, Fatigue Failure, Notch Sensitivity, Design for Finite and Infinite Life, Cumulative Damage Soderberg and Goodman Diagrams,. (Numerical treatment included)
Theories of Failure: Maximum Normal Stress Theory, Maximum Shear Stress Theory, Maximum Distortion Energy Theory, Comparison of Theories, Combined Loading Applications

Unit 3: Design of Shafts, Keys and Couplings
Types of Shafts: Transmission Shafts, Spindles, Axles , Design for Strength and Rigidity (Torsional & Bending), ASME Code for Shaft Design, Types of Keys: Flat, Square; Design and Fitment, Splined Shafts Overview, Design of Rigid Couplings: Muff, Flange, Design of Flexible Couplings: Bush pin, etc.

Unit 4: Design of Power Screws and Welded Joints
Power Screws: Types of Threads, Terminology, Torque for Lifting/Lowering, Self-Locking, Efficiency, Overall and Thread Efficiency, Design of Screw, Nut, Compound, Differential Screws, Introduction to Recirculating Ball Screw, Welded Joints: Types (Butt, Fillet), Strength Calculations, Welded Joints under Eccentric Load and Bending.

Unit 5: Design of Mechanical Springs
Springs: Types and Applications, Terminology and Material Selection, Helical Compression Springs: Stress-Deflection Equation, Wahl’s Factor, End Styles, Shot Peening, Design of Tension and Compression Springs, Torsion Springs, Multi-leaf Springs, Nipping Concept,

Texts:

1. V. B. Bhandari – *Design of Machine Elements*, Tata McGraw Hill Publication

References:

1. Shigley J. E. & Mischke C. R. – Mechanical Engineering Design, Tata McGraw Hill
2. M. F. Spotts – Design of Machine Elements, Pearson Education
3. Robert L. Norton – Machine Design: An Integrated Approach, Pearson.

Course Code:
Course Title: Pneumatics & Hydraulics

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs /week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course the student will be able to:

CO1	Exemplify the basic principles of Industrial fluid power.
CO2	Select and specify various components for hydraulic and pneumatic systems.
CO3	Execute PLC program for electro-hydraulic circuit applications.
CO4	Organize hydraulic and pneumatic circuits for given application.
CO5	Evaluate the hydraulic and pneumatic systems based on various evaluation criteria.

Mapping of course outcomes with program outcomes

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

Course Content

Unit 1: Introduction to Fluid Power and Automation

Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. Properties of fluids, Fluids for hydraulic systems, governing laws.

Unit 2: Hydraulic Pumps and Actuators Pumps

Classification of pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps. Design of reservoir capacity. Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).

Unit 3: Control Components in Hydraulic System

Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated

DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.

Unit 4: Hydraulic Circuit Design and Analysis

Control of Single and Double -Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Speed Control of Hydraulic Cylinder and motors, Safety circuit, Accumulators, types, construction and applications with circuits, Intensifier circuits and their applications, Proportional control valves and servo valves.

Unit 5: Introduction to Pneumatic system

Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit. Pneumatic Actuators: Linear cylinder Types, Cascade design of Pneumatic circuit, Use of Logic gates - OR and AND gates in pneumatic applications.

Texts/ References:

1. Esposito Anthony, Fluid power with Applications, Pearson, ISBN: 978-81-7758- 580-3
2. Mujumdar S.R., Pneumatic Systems, Tata McGraw Hill, 2002 Edition. ISBN: 9780074602317.
3. Bolton W., Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering, Pearson, Education (Singapore) Pvt Ltd.
4. Industrial hydraulics manual by Vickers, Inc.
5. Fluid Power: Generation, Transmission and Control, Wiley, 2018, ISBN: 9788126539543
6. Peter Rohner, Industrial hydraulic control, Hydraulic Supermarket, 2005, ISBN 978 0958149310

Course Code:
Course Title: Virtual Instrumentation

Teaching Scheme	Examination Scheme:
Lecture: 3 hrs/week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 3 hrs)

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand Virtual Instrument concepts
CO2	Study the various tools in graphical programming
CO3	Design a Virtual interface using graphical programming
CO4	Develop systems for real-time signal acquisition and analysis
CO5	Implement and design data acquisition systems for practical applications
CO6	Suggest solutions for automation and control applications using virtual instrumentation.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			1			1				3
CO2	2	2	1									3
CO3	2	1	1		2			1				2
CO4	1	2		1				1				3
CO5	3	1	1	1				1				2

Course Contents

Unit 1: Introduction to Virtual Instrumentation
Conventional instruments, Virtual Instruments - Architecture, Physical quantities and Analog interfaces - hardware and software- user interfaces, advantages of virtual instrumentation over conventional instruments, Graphical programming language.

Unit 2: Graphical Programming Environment
Concepts of graphical programming – Concept of VIs and sub VIs, Display types - Digital – Analog Chart, Oscilloscope types.

Unit 3: Graphical Programming Control Structures
Data flow programming modular programming, Loops local and global variables Case and sequence structures, Types of data Arrays Formulate nodes - String and file I/O. Lab VIEW: Basic arithmetic operations, Boolean operations.

Unit 4: Cluster of Instruments in Interfacing Systems
Interfacing of external instruments to a PC – RS 232C, RS – 422, RS 485 and USB standards – IEEE 488 standard – introduction to bus protocols of MOD bus and CAN bus, Interfacing the protocols with the virtual environment.

Unit 5: Real Time Controller Design
Real time controller Designs using Virtual Instrumentation Software - ON/OFF controller –P-I-D controller – Proportional controller – Modeling and basic control of level and reactor processes – Case studies on development of supervisory control in VI

Texts:

1. Sanjay Gupta, Joseph John, Virtual Instrumentation using Lab VIEW, Tata McGraw Hill, New Delhi, 2010.

References:

1. Johnson G, Jennings R, Lab VIEW Graphical Programming, Tata McGraw Hill, New York, 2006.
2. Jovitha Jerome, Virtual Instrumentation using Lab VIEW, PHI Learning Pvt. Ltd, New Delhi, 2010.

Course Code:

Course Title: Machine Vision System

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 3 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand digital image using various algorithms with the help of computer programming.
CO2	Understand the role of image processing in different fields such as medical, engineering, space, biotechnology, ocean, agriculture, food industry, etc.
CO3	Realize the significance of digital image processing in automation.
CO4	Understand models for image degradation/restoration.
CO5	Know the mathematical calculations of basic filters used in digital image enhancement.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit 1: Fundamentals of Image Processing

Definition of image, basics of image processing, Human visual system, Sampling & quantization, Representing digital images, Spatial & gray-level resolution, Image file formats, Basic relationships between pixels, Distance Measures. Basic operations on images-image addition, subtraction, logical operations, scaling, translation, rotation. Image Histogram. Color fundamentals & models – RGB.

Unit 2: Image Enhancement and Restoration

Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency domain. Homomorphic filtering. Restoration: Noise models, Restoration using Inverse filtering and Wiener filtering

Unit 3: Image Compression Techniques
Types of redundancy, Fidelity criteria, Lossless compression – Run length coding, Huffman coding, Bit-plane coding, Arithmetic coding. Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG.

Unit 4: Image Segmentation and Morphological Operations
Image Segmentation: Point Detections, Line detection, Edge Detection-First order derivative – Prewitt and Sobel. Second order derivative – LoG, DoG, Canny. Edge linking, Hough Transform, Thresholding – Global, Adaptive. Otsu's Method. Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.

Unit 5: Object Recognition and Applications
Feature extraction, Patterns and Pattern Classes, Representation of Pattern classes, Types of classification algorithms, Minimum distance classifier, Correlation based classifier, Bayes classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical application of Image processing

Texts:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, - Pearson Education.
2. S Sridhar, "Digital Image Processing", Oxford University Press.

References:

1. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, "Digital Image Processing Using MATLAB", Second Edition, - Tata McGraw Hill Publication
2. S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing",
3. Tata McGraw Hill Publication
4. Scott E Umbaugh, Digital Image Processing and Analysis: Applications with MATLAB and CVIP tools , Taylor and Francis, ISBN: 1498766072
5. Scott EUmbaugh, Computer Vision and Image Processing Prentice-Hall International, ISBN: 9781439802052
6. A.K. Jain, Fundamentals of Digital Image Processing, Prentice-Hall of India, ISBN-100133361659

Course Code:
Course Title: PLC and SCADA

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 3 hrs)

Course Outcomes: At the end of the course, students will be able to

CO1	To learn PLC components and I/O processing in PLC
CO2	To learn programming of PLC
CO3	To study PLC interface to various circuits
CO4	To study SCADA and HMI.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents

Unit 1: PLC and I/O Processing

Programmable Logic Controller basics, overview of PLC systems – Architecture of PLC, Principle of Operation, input/output Units – power supplies and isolators, current sinking and current sourcing, types of PLC memory, fundamental PLC wiring diagram, relays, switches, transducers, sensors –seal-in circuits. Input/output units Signal conditioning. Remote connections Networks Processing inputs I/O addresses

Unit 2: Programming of PLC

Fundamentals of logic, PLC programming languages. Ladder diagrams, Ladder Diagram Instruction, Logic functions, Latching, Multiple outputs. Timer and counter- types along with timing diagrams, shift registers, sequencer function, latch instruction; Arithmetic and logical instruction with various examples. ON/OFF switching devices, I/O analog devices, Analog PLC operation, PID control of continuous processes, simple closed loop systems, closed loop system using Proportional, Integral & Derivative (PID).

Unit 3: PLC interface to various Circuits

Encoders, transducer and advanced sensors. Measurement of temperature, flow, pressure, force, displacement, speed, level. Developing a ladder logic for Sequencing of motors, Tank level control, ON-OFF temperature control, elevator, bottle filling plant, car parking etc. Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

Unit 4: SCADA Systems

Introduction, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution).

Unit 5 : HMI (Human Machine Interface) :

Getting started with HMI, creating applications, creating tags, Downloading / uploading programs, Communication with PLC Open systems interconnection (OSI) Model, Process Field bus (Profibus). Interfacing of SCADA with PLC, PLC interface, and Industrial process example

References:

1. Stuart A. Boyer: “SCADA- Supervisory Control and Data Acquisition”, Instrument Society of America Publications, USA, The Instrumentation system and Automation Society, 4th Edition, 2010.
2. Gordon Clarke, Deon Reynders” Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes An imprint of Elsevier Publications, 1st Edition, 2004
3. Batten G. L., “Programmable Controllers”, McGraw Hill Inc., Second Edition
4. Gordan Clark, Deem Reynders, “Practical Modern SCADA Protocols”, ELSEVIER
5. P. K. Srivstava, “Programmable Logic Controllers with Applications”, BPB Publications.

Course Code:
Course Title: Control System Engineering

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 3 hrs)

Course Outcomes: At the end of the course, students will be able to**:**

CO1	Understand the basic concept of control engineering
CO2	Understand the modeling of linear invariant systems using transfer function and state space representations.
CO3	Understand the concept of stability and its assessment for linear time invariant systems.
CO4	Design simple feedback controllers
CO5	Represent the system in the state space form for the analysis

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PO12
CO1	2	1	1		1			2				1
CO2	2	2	1		2							
CO3	2	1	1		1			2				1
CO4	3	2	3	1	2							2
CO5	3	1	2		2			3				3

Course Contents

Unit 1:

Introduction to control system problem, Industrial Control System examples, Transfer function, System with dead-time, System response, Control hardware and their models, potentiometers, synchro"s, LVDT, dc and ac servomotors, tacho-generators, electrohydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators, closed-loop systems: Block diagram and signal flow graph analysis.

Unit 2:

Feedback control systems stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems. feed-forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Unit 3:
Time response of second-order systems, steady-state errors and error constants, Performance specifications in time-domain, Root locus method of design., Lead and lag compensation.

Unit 4:
Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots, Nyquist stability criterion, Performance specifications in frequency-domain, Frequency-domain methods of design, Compensation & their realization in time & frequency domain, Lead and Lag compensation, Op-amp based and digital implementation of compensators, Tuning of process controllers, State variable formulation and solution

Unit 5:
State variable Analysis- Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

Texts/References:

1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.
2. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
3. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.
4. Nagrath & Gopal, "Modern Control Engineering", New Age International, New Delhi.
5. Ambikapathy A., Control System, Khanna Book Publishing Company, 2018.

Course Code:
Course Title: Mechatronics Lab

Teaching Scheme	Examination Scheme
Practical: 2 hrs/week Credits: 1	Continuous Assessment: 60 Marks Oral/ Practical: 40 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

List of Practical/Experiments (Any Five)

1. Study and demonstration of various types of sensors.
2. Speed control of various types of Electrical Motors.
3. Minimum two circuits on Pneumatics to be developed on Pneumatic trainer kit.
4. Minimum two circuits on Electro-Pneumatics to be developed on Electro-pneumatic trainer kit.
5. Minimum two circuits on Hydraulics and Electro-hydraulics to be developed on Hydraulic trainer kit.
6. Programming of Microprocessor and Microcontroller
7. Programming on PLC.
8. Demonstration of Process control such as temperature, level, flow, etc. control using PID controller.

Course Code:
Course Title: Machine Design Practice-I

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs./week Credits:1	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

Pre-requisite: MD I (Theory)

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

List of Practical/Experiments/Assignments

1. The term work shall consist of two design projects based on the syllabus of Machine Design - I. Each design project shall consist of two imperial size sheets - one involving assembly drawings with a part list and overall dimensions and other sheet involving drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified, wherever necessary, so as to make it working drawing
2. A design report giving all necessary calculations for the design of components and assembly should be submitted in a separate file.
3. Two assignments based on topics of syllabus of Machine Design – I.

Course Code:
Course Title: Hydraulics & Pneumatic Lab

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs./week Credits:1	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

List of Practical's/ Experiments

1. Experiment on measurement of hydraulic pump efficiency.
2. Experiment on meter in and meter out circuit.
3. Experiment on design of regenerative circuits.
4. Experiment on design of electro-hydraulic sequencing circuits.
5. Experiment on pneumatic circuits by demonstrating logic gates.
6. Experiment on electro-pneumatic circuits.
7. Experiment on programmable logic controllers: Ladder logic programming.
8. Microprocessor programming for basic operations.

Course Code:

Course Title: Technical Project Related to Community Services

Teaching Scheme	Examination Scheme
Practical: 02 hrs/ week Credits: 01	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

Course Objectives: The main objective of TPCS is to let the students apply the knowledge of theoretical concepts which they have learnt as a part of the curriculum of the undergraduate courses to real time problems or situations related to community and societal issues.

Course Guidelines:

- Students can choose projects based on societal problems or user defined problem which must emulate real-life problems and useful for the community.
- It is desirable that students should work on the project in groups of 2 or 3 but not more than three.
- After making the group, students must decide the title of the project in consultation with the guide and finalize the topic. Topics may be found by looking through recent issues of peer reviewed Journals/Technical Magazines on the topics of potential interest
- Each student is requested to develop a working model/ process/ software package /system on the chosen work and demonstrate before the evaluation committee (Guide & Internal Examiner)

- Finally, students must submit the final report of the project and the format for the same will be given by the department.
- The students will report to the respective guide/supervisor every fortnight to discuss their progress.
- The final evaluation of the project will be done based on the demonstration and presentation. It is mandatory for the student to:

    i. appear for final presentation (PPT with informative slides) and viva-voce to qualify for course evaluation
    ii. submit a well-documented TPCS report as per the format.

Course Evaluation:

Evaluation weightage for the TPCS is as follows:

- TPCS Supervisor Assessment 30%
- Working model / process / software package / system developed (20%)
- TPCS report (20%)
- Final presentation (with PPT) and viva-voce (30%)
- The student must register for the TPCS project as supplementary examination in the following cases:

    i. he/she is absent for oral presentation and viva-voce
    ii. he/she fails to submit the report in prescribed format
    iii. he/she fails to fulfil the requirements of Mini project evaluation as per specified guidelines.

Course Code:
Course Title: Field /Industrial Training – I (To be completed)

Teaching Scheme	Examination Scheme
Credits: --	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: --

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

The students should complete their training by the end of this semester. The students are expected to understand the industrial processes, tools, equipment, & safety rules. Besides, it is expected to improve the technical skills, communication, teamwork, problem-solving ability, and professional behaviour through hands-on experience and interaction with industry experts.