CURRICULUM & SYLLABUS

For

B.E. (Hons.) Mechanical Engineering with specialization in Robotics

(Choice Based Credit System)

(With effect from 2018)

DEPARTMENT OF MECHANICAL ENGINEERING

SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDYALAYA

SCSVMV

(Deemed to be University U/S 3 of UGC Act 1956)

Accredited with "A" Grade by NAAC

Enathur, Kanchipuram – 631 561

These regulations are applicable to the students admitted from the AY 2019-20 onwards.

1. PRELIMINARY DEFINITIONS AND NOMENCLATURE

1. "**Degree**" referred to as Under-Graduate (UG) Degree, i.e., B.E. Degree.
2. **"Honours** Degree**"** referred to as Under-Graduate (UG) Degree specialization in emerging area of Home Discipline i.e., Mechanical Engineering to facilitate the students to choose additionally the specialized courses of their choice and to build their competence in special area. Students have to undergo additional courses and acquire more than required number of credits & maintaining CGPA – 8.0 during their period of study (4 years) and no history of arrears to obtain B. E (Hons)**.**
3. **"**Minor **Degree"** referred to as Under-Graduate (UG) Degree specialization in emerging areas other than the chosen discipline of Engineering. Students have to undergo additional courses in their special areas of interest and earn additional credits to obtain B. E with Minor Specialization.
4. **"**Programme" referred to as discipline of B.E. Degree programme like Mechanical Engineering.
5. **"Course"** referred to as a theory/practical subject studied in a semester.

2. ELIGIBILITY FOR ADMISSION

1. **Regular Admission**
   - Maximum age limit for the full-time course is 20 years.
   - Students seeking admission to the first semester of the eight semester B.E. -Degree programme shall be required to have a pass in Higher Secondary Examinations (Academic 10+2) or its equivalent examinations in any State/CBSE/IGCSE board with Mathematics, Physics and Chemistry. Passed 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry / Biotechnology / Biology / Technical Vocational subject / Computer Science / Information Technology / Informatics Practices / Agriculture / Engineering Graphics / Business Studies.
   - Obtained at least 50%, Marks (40% marks in case of candidates belonging to reserved category) in the above subject taken together.

2. **Lateral Entry Admission**
   Students who possess the Diploma in Engineering (Mechanical/Automobile or its equivalent) awarded by the State Board of Technical Education, Tamil Nadu

or its equivalent board are eligible to apply for Lateral entry admission to the third semester of B.E. Programme.

3. COURSES OFFERED

COURSE - I	:	B.E. – MECHANICAL ENGINEERING
COURSE – II	:	B.E. (HONS.) – MECHANICAL ENGINEERING in Specialization with 3D Printing
COURSE – III	:	B.E. (HONS.) – MECHANICAL ENGINEERING in Specialization with Electric Vehicles
COURSE – IV	:	B.E. (HONS.) – MECHANICAL ENGINEERING in Specialization with Robotics
COURSE – V	:	B.E. – MECHANICAL ENGINEERING with Minor degree in Cyber Security
COURSE – VI	:	B.E.– MECHANICAL ENGINEERING with Minor degree in Internet of Things (IoT)
COURSE – VII	:	B.E.-MECHANICAL ENGINEERING with Minor degree in Artificial Intelligence & Machine Learning
COURSE – VIII	:	B.E.–MECHANICAL ENGINEERING with Minor degree in Sensor Technology

A student may be offered admission to any one of the programmes of study. The recommended credit range for the above programmes are in between 170 to 192.

4. STRUCTURE OF PROGRAMMES

1. Categorization of Courses

Each B.E., programme will have a curriculum with syllabi comprising of Theory and Practical courses with well-defined Program Outcomes and Programme Educational Objectives (PEO) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses of a programme are categorized as follows:

1. **Basic Science Courses (BSC)** include Mathematics, Physics, Chemistry, Biology, Environmental Sciences, etc.
2. **Engineering Science Courses (ESC)** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering, Instrumentation etc.
3. **Professional Core Courses (PCC)** include the core courses relevant to the Mechanical Engineering & chosen specialization.
4. **Professional Core Elective Courses (PCEC)** include the elective courses relevant to the chosen specialization.
5. **Professional Specialised Courses (PSC)** include the specialised courses relevant to the chosen specialization.
6. **Humanities and Social Sciences including Management courses (HSMC) & Open Electives Courses (OEC)** provide an opportunity to study a course from any discipline that includes the courses relevant to the chosen specialization. The student can choose from the curriculum of other B.E. / B. Tech. programmes and the courses offered by the Departments under the Faculty of Science and Humanities.
7. **Project Mechanical Engineering courses (PROJ-ME)**
8. **Mandatory Courses (MC) non-credit courses such as** Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge

2. Mandatory Two-Week Induction Programme

The students are expected to undergo a mandatory two-week induction programme comprising of physical activity, creative arts, universal human values, proficiency modules, lectures by eminent people, visits to local areas and familiarization to department/branch & innovations immediately after admission.

3. Number of courses per semester

The Curriculum of a semester shall normally have a blend of 4 to 7 lecture courses, except the final semesters, and 2-3 laboratory courses. However, the total number of courses per semester shall not exceed 10 (including EEC). Pre-final semester may have 1 design Project. The final semester may have a blend of 2 or 3 lecture courses and 1 innovative Project.

4. Credit Assignment

In assigning the credits for the courses, 1-hour lecture/week, 1-hour tutorial/week, 2 hours practical/week, 2 hours project work or seminar/week is equivalent to 1 credit.

5. Industrial Training / Internship

Student is expected to undergo In-plant training in any industry/organization during the programme of study. Every 2 weeks of internship/training at industry is equivalent to 1 credit. The credit will be awarded to the student based on the recommendation by the evaluation team, and the results will be sent to The Controller of Examinations after the approval by the Head of the Department.

6. Industrial Visit

Student is required to go for at least one Industrial Visit every year, starting from the second year of the Programme. The Heads of Departments shall ensure that necessary arrangements are made in this regard.

7. Medium of Instruction

The medium of instruction is English for all courses.

5. DURATION OF THE PROGRAMMES

1. A student is normally expected to complete the B.E. Programme in 4 years (8 Semesters), but in any case, not more than 7 years (14 Semesters).
2. Each semester shall normally consist of 90 working days (including examination days). The Head of the Department shall ensure that every faculty imparts instruction as per the number of periods specified in the syllabus, covering the full content of the syllabus for the course being taught.
3. **The** total duration for completion of the programme reckoned from the commencement of the first semester to which the student was admitted shall not exceed the maximum duration irrespective of the period of break of study.

6. COURSE ENROLLMENT AND REGISTRATION

1. Student, on admission, shall be assigned to a Faculty Advisor, who shall advice and counsel the student about the details of the academic programme and the choice of courses, considering the student's academic background and career objectives.

2. After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn continuous assessment marks and appear for the end semester examinations.
3. Each student on admission shall register for all the courses prescribed in the curriculum.
4. If a student fails to secure a pass in any theory or Laboratory course (including elective theory), he/she shall register for the same course in the immediate semester examinations by retaining the Continuous Assessment Marks already earned.
5. The student shall register Project-1 in VII Semester and Project-2 in VIII Semester.
6. The student who fails in any Project work (Project 1 / Project 2) shall register for the course again. In this case, the student shall attend the reviews and fulfil the attendance requirements.

7. RE`QUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION

1. Student who has fulfilled the following conditions shall be deemed to have satisfied the attendance requirements for appearing for the end semester examination of a particular course.
2. Ideally every student is expected to attend all periods and earn 100% attendance. However, the student shall secure not less than 80% attendance, course wise, taking into account the number of periods required for that course, as specified in the curriculum.
3. If a student secures attendance between 70% and less than 80% in any course in the current semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level Sports events, with prior permission from the Sports director, and Head of the Department concerned, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the end semester examination of that course.
4. In all such cases, the students should submit the required documents on joining after the absence to the Head of the Department through the Faculty Advisor.
5. A student with an attendance between 40% and 70% in any course will fall under the category **"Semester Break"**, which means Students will not be permitted to attend the Regular End Semester Examinations for that course. If

a student has short fall of attendance in all the registered courses in "Semester Break", he/she would be permitted to move to the higher semester and has to repeat the current semester in the subsequent semester.

6. The student, whose attendance falls below 40% for a course in any semester, will be categorized as **"Detained"**, which means detained in the particular course for want of attendance and they will not be permitted to write the End semester exam for that course. Students will be asked to repeat the same course in the next year.
7. A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear for the same course for improvement of grades.

8. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty of the Department, who shall function as Faculty Advisor for those students throughout their period of study. The Faculty Advisor shall advise the students in registering and reappearance (Arrear) registering of courses, authorize the process, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress / performance of the students concerned.

9. CLASS COMMITTEE

The objective of the Class Committee is to improve the teaching-learning process. The functions of the class committee include:

1. Resolving difficulties experienced by students in the classroom and in the laboratories.
2. Clarifying the regulations of the degree programme and the details of rules therein.
3. Discussing the progress of academic schedule and deviations if any.
4. Evaluating the performance of the students of the class after each test and finding the ways and means of improvement.
5. Class committee consisting of faculty members who are teaching in that class, student representatives and a Head of the Department

6. The class committee shall meet 2-3 times in a semester as specified in the academic calendar. The Dean (Engg. & Tech) may participate in any class committee of the institution.
7. During these meetings, the representative of the class shall meaningfully interact and express the opinions and suggestions of the other students of the class to improve the effectiveness of the teaching-learning process.
8. The Head of the Department is required to prepare the minutes of the meeting, signed by the members and submit the same to Dean. In each meeting, the action taken report of the previous meeting is to be presented by the HOD.

10. SYSTEM OF EXAMINATION

Performance in each course of study shall be evaluated for a maximum of 100 marks based on one of the following:

1. Continuous assessment throughout the semester and a terminal examination at the end of the semester. The continuous assessment will carry 40 marks while the end-semester examination will carry 60 marks.
2. The end semester examination (Theory & Practical) of 3 hours duration shall be conducted by the Controller of Examinations between October to December during the Odd Semesters and between April to May during the Even semesters. All Practical examinations shall be conducted and evaluated at the Department itself on behalf of the Controller of Examinations.
3. For all the practical courses, students shall obtain bonafide certificate for the Observation cum Record completed from the Faculty in-charges / Head of the Department on or before the day of the practical examination.
4. For the project works, students shall obtain bonafide certificate for the project work completed from the project Guide and Head of the Department, at the end of the semester.
5. The semester examination for project work shall comprise of evaluation of the final report submitted by the project group (of not exceeding 4 students) by an external examiner. Further, the performance of each student of the project group would be evaluated in a viva-voce examination conducted by a committee consisting of an external examiner appointed by the Head of the Department/the Controller of Examination, Head of the Department or faculty nominated by Head of the Department and Guide of the project group.

6. Student can apply for re-valuation of his/her semester examination answer paper in theory courses within the stipulated period from the declaration of results, on payment of a prescribed fee, as specified by the Controller of Examinations from time to time. The Controller of Examination will arrange for going through the answer scripts by the students and to make appeals. The re-valuation results will be published before the commencement of supplementary examinations. Re-valuation is not permitted for practical courses, project work and industry supported courses.

11. PROCEDURE FOR AWARDING MARKS FOR CONTINUOUS ASSESSMENT

1. Theory courses

1. The award of marks for continuous assessment shall be normally based on two internal assessment tests and five Assignments / tutorials / seminars. The apportioning of marks shall be as follows:
    1. 30 marks for tests
    2. 10 marks for assignments/tutorials/seminars/Attendance

   However, the assessment pattern for awarding the continuous assessment marks may be designed by the course designers based on the nature of the course and is to be approved by the Academic Council.
2. The first and second Continuous Assessment Tests will be normally conducted at the mid and end of the semester respectively. Each test carries maximum of 30 marks.
3. There will be five assignments for each course which will be considered for awarding marks for assignment.
4. Both test and assignment marks put together is 40 marks maximum.
5. If a student fails in a theory course, the Continuous Assessment Marks already earned will be retained for subsequent reappearances.

2. Practical courses

The continuous assessment mark will be awarded as follows:

Observation-cum-Record in regular class works	: **15 marks**
Model Test	: **15 marks**
Viva	: **10 marks**

3. Project work

Head of the Department shall constitute a review committee comprises of Head of the Department or Faculty member nominated by Head of the Department and two faculty members. The student shall make presentation on the progress made by him / her before the committee. The total marks obtained in the three reviews shall be averaged to 40 marks.

- Every faculty member is required to maintain an Attendance and Continuous Assessment Record which consists of attendance marked for each lecture or practical or project work classes, the tests & assignment marks and record of class works (topics covered) separately for each course.

12. ELIGIBILITY FOR PASS IN EACH COURSE

1. A student who secures not less than 50% of total marks (both continuous assessment and end semester examination marks put together) in theory courses, practical courses shall be declared to have passed the examination.
2. If a student fails to secure a pass in a particular course, it is mandatory that he/she shall register for that course in the subsequent semester and attend the end semester examination. He/she should continue to register and appear for the examination till he /she secures a pass.
3. **Award of Grades**

Range of Total marks (Continuous assessment + End semester examination)	Letter Grade	Grade Point (GP)
Between 90 to 100	S	
Between 80 to 89	A	
Between 70 to 79	B	
Between 60 to 69	C	
Between 55 to 59	D	
Between 50 to 54	E	
Between 0 to 49	F	
Absent	AB	

Grade Point Average $GPA=\frac{\sum_{i=1}^{N} C_i G_{P_i}}{\sum_{i=1}^{N} C_i}$

N is the number of courses registered in a particular semester,
GP_i is the grade point obtained in i^{th} course and
C_i is the number of credits assigned to i^{th} course.

Cumulative GPA (CGPA) will be calculated when the student is declared to be eligible for the award of the degree. CGPA calculation is based on all the courses considered for the award of the degree.

13. ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared to be eligible for the award of the degree if he/she has satisfied the following:

1. A student seeking B.E., degree shall be required to undergo the prescribed courses of study and evaluation in the college for the specified duration and to pass all the examinations prescribed therefore.
2. He/ she should register for the courses prescribed in the curriculum of the respective degree programme, fulfil the requirement of credits in each category of credit distribution, pass in all mandatory courses in the curriculum and earn the specified total minimum number of credits.
3. No disciplinary action pending against the student.

14. CLASSIFICATION OF THE DEGREE AWARDED

1. **First class with Distinction**
   A student who qualifies for the award of degree having passed the examination in all registered courses in his / her first appearance (including industry supported courses), within Four years (Three Years for Lateral Entry students), and securing a CGPA of not less than 8.50 shall be declared to have passed in First class with distinction.

2. **First Class**
   A student who qualifies for the award of degree having passed the examination in all the courses within Four years (Three years for Lateral Entry students) and securing a CGPA of not less than 7.00 shall be declared to have passed in First class.

3. **Second Class**
   All other students (not covered in 14.1 and 14.2) who qualify for the award of degree having passed the examination in all the courses and fulfilling the requirements shall be declared to have passed in Second Class.

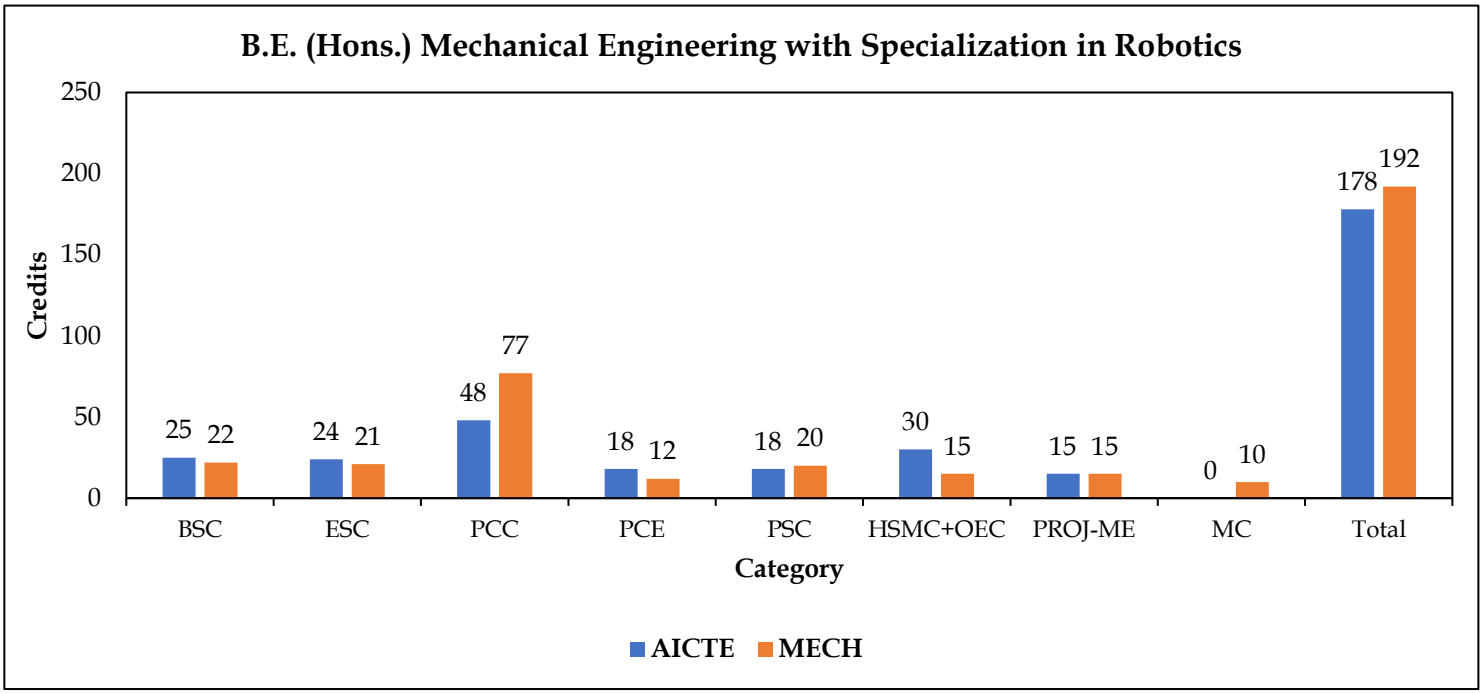
15. DISCIPLINE

1. Every student is required to observe discipline and decorous behavior both inside and outside the college and not to indulge in any activity, which will tend to bring down the prestige of the college. The Registrar shall constitute a disciplinary committee to enquire into acts of indiscipline and notify the institution about the disciplinary action recommended for approval. In case of any serious disciplinary action which leads to suspension or dismissal.
2. If a student indulges in malpractice in any test/examinations, the student shall be liable for punitive action as prescribed by the institution from time to time.

16. REVISION OF REGULATIONS AND CURRICULUM

The standing committee/Academic Council/ of the institution reserves the right to revise or change or amend the regulations, the scheme of examinations, the curriculum and the syllabi from time to time if found necessary.

DISTRIBUTION OF CREDITS				
SL. No	**Course Category**	**As per AICTE regulation 2018**	**Credits**	**Percentage (%)**
1.	**Basic Science Courses (BSC)**	**25**	**22**	13.5
2.	**Engineering Science Courses (ESC)**	**24**	**21**	13.1
3.	**Professional Core Courses (PCC)**	**48**	**79**	48.1
4.	**Professional Core Electives Courses (PCE)**	**18**	**12**	7.5
5.	**Professional Specialised Courses (PSC)**	**18**	**20**	12.5
6.	**Humanities and Social Sciences including Management courses (HSMC) + Open Electives Courses (OEC)**	**30**	**15**	9.3
7.	**Project Mechanical Engineering courses (PROJ-ME)**	**15**	**15**	9.3
8.	**Mandatory Courses (MC)***	**0**	**8***	*
* **Not accountable for CGPA**				
Total		**178**	**192**	**100**



EACH COURSE IN CATEGORY WISE								
B.E. (HONS.) MECHANICAL ENGINEERING WITH SPECIALIZATION IN 3D PRINTING								
Basic Science Courses (BSC)								
SL. No	**Semester**	**Course Category**	**Course Code**	**Name of the Course**	**Hours per week**			**Credit**
					L	**T**	**P**	
1	1	BSC		Mathematics –I (Calculus & Linear Algebra)	3	1	-	**4**
2	1	BSC		Engineering Chemistry	3	-	-	**3**
3	1	BSC		Chemistry Lab	-	-	3	**2**
4	2	BSC		Mathematics – II (Calculus, Ordinary Differential Equations, and Complex Variables)	3	1	-	**4**
5	2	BSC		Applied Physics for Engineers	3	-	-	**3**
6	2	BSC		Physics Lab	-	-	3	**2**
7	3	BSC		Mathematics III (PDE, Probability & Statistics)	3	1	-	**4**
Total Credits								**22**

Engineering Science Courses (ESC)								
SL. No	**Semester**	**Course Category**	**Course Code**	**Name of the Course**	**Hours per week**			**Credit**
					L	**T**	**P**	
1	1	ESC		Basic Electrical Engineering	3	-	-	**3**
2	1	ESC		Engineering Graphics & Design	2	-	2	**3**
3	1	ESC		Basic Electrical Engineering Lab	-	-	3	**2**
4	2	ESC		Programming for Problem Solving	2	1	-	**3**
5	2	ESC		Programming for Problem Solving Lab	-	-	3	**2**
6	2	ESC		Workshop/Manufacturing Practices Lab	-	-	3	**2**
7	3	ESC		Engineering Mechanics	2	1	-	**3**
8	4	ESC		Basic Electronics Engineering	3	-	-	**3**
Total Credits								**21**

Humanities and Social Sciences including Management courses (HSMC)								
SL. No	Semester	Course Category	Course Code	Name of the Course	Hours per week			Credit
					L	T	P	
1	2	HSMC		English	2	1	-	**3**
2	6	HSMC		Operation Research & Management	2	1	-	**3**
3	8	HSMC		Engineering Economics	3	-	-	**3**
Total Credits								**09**

Mandatory Courses (MC)								
SL. No	Semester	Course Category	Course Code	Name of the Course	Hours per week			Credit
					L	T	P	
1	1	MC*		English Proficiency Certification	2	-	-	**1***
2	2	MC*		Environmental Science and Engineering*	2	-	-	**1***
3	3	MC*		Foreign Language Level – II and Above	-	-	-	**1***
4	4	MC		Sanskrit and Indian Culture	2	-	-	**1***
5	5	MC*		Soft Skill and Aptitude Certification	-	-	-	**1***
6	6	MC*		Technical Certification Course	-	-	-	**1***
7	7	MC*		Presentation / Publication in Conference / Seminar	-	-	-	**1***
8	8	MC*		Start ups				**1***
Total Credits								**8**

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Professional Core Courses (PCC)								
SL. No	Semester	Course Category	Course Code	Name of the Course	Hours per week			Credit
					L	T	P	
1.	3	PCC		Fluid Mechanics & Machinery	2	1	-	**3**
2.	3	PCC		Thermodynamics	3	-	-	**3**
3.	3	PCC		Materials Engineering	3	-	-	**3**
4.	3	PCC		Fluid Mechanics and Machinery Lab	-	-	3	**2**
5.	3	PCC		Materials and Metallurgy Lab	-	-	3	**2**
6.	4	PCC		Applied Thermodynamics	3	-	-	**3**
7.	4	PCC		Strength of Materials	2	1	-	**3**
8.	4	PCC		Kinematics of Machines	2	1	-	**3**
9.	4	PCC		Manufacturing Processes	3	-	-	**3**
10.	4	PCC		Thermal Engineering Lab	-	-	3	**2**
11.	4	PCC		Strength of Materials Lab	-	-	3	**2**
12.	5	PCC		Heat and Mass Transfer	3	-	-	**3**
13.	5	PCC		Dynamics of Machines	2	1	-	**3**
14.	5	PCC		Instrumentation and Control	3	-	-	**3**
15.	5	PCC		Design of Machine Elements	3	-	-	**3**
16.	5	PCC		Manufacturing Technology	3	-	-	**3**
17.	5	PCC		Metrology and Quality Control	3	-	-	**3**
18.	5	PCC		Machine Drawing Practical	-	-	3	**2**
19.	5	PCC		Manufacturing Technology Lab	-	-	3	**2**
20.	5	PCC		Dynamics and Measurements Lab	-	-	3	**2**
21.	6	PCC		Automobile Engineering	3	-	-	**3**
22.	6	PCC		Power Plant Engineering	3	-	-	**3**
23.	6	PCC		CAD/CAM	3	-	-	**3**
24.	6	PCC		Heat Transfer Lab	-	-	3	**2**
25.	6	PCC		CAD/CAM Lab	-	-	3	**2**
26.	7	PCC		Design of Transmission Systems	3	-	-	**3**
27.	7	PCC		Mechatronics	3	-	-	**3**
28.	7	PCC		Computer Aided Analysis Lab	-	-	3	**2**
29.	7	PCC		Mechatronics Lab	-	-	3	**2**
30.	8	PCC		Automation in Manufacturing	3	-	-	**3**
Total Credits								**79**

Professional Core Electives Courses (PCE)								
SL. No	Semester	Course Category	Course Code	Name of the Course	Hours per week			Credit
					L	T	P	
1.	6	PCE -I		Finite Element Analysis	3	-	-	3
2.	6	PCE -I		Fluid Power Systems	3	-	-	
3.	6	PCE -I		Product Design & Development	3	-	-	
4.	6	PCE -I		3D Printing	3	-	-	
5.	6	PCE -I		Tribology	3	-	-	
6.	7	PCE - II		Refrigeration & Air Conditioning	3	-	-	3
7.	7	PCE - II		I.C. Engines	3	-	-	
8.	7	PCE - II		Turbo Machines	3	-	-	
9.	7	PCE - II		Energy Conservation in Industries	3	-	-	
10.	7	PCE - II		Gas Dynamics & Jet Propulsion	3	-	-	
11.	7	PCE - III		Sustainable Manufacturing	3	-	-	3
12.	7	PCE - III		Design for Manufacturing	3	-	-	
13.	7	PCE - III		Theory of Metal Forming	3	-	-	
14.	7	PCE - III		Digital Manufacturing	3	-	-	
15.	7	PCE - III		Composite Materials	3	-	-	
16.	8	PCE - IV		Total Quality Management	3	-	-	3
17.	8	PCE - IV		Entrepreneurship Development	3	-	-	
18.	8	PCE - IV		Non-Traditional Machining Process	3	-	-	
19.	8	PCE - IV		Non Destructive Evaluation	3	-	-	
20.	8	PCE - IV		Flexible Manufacturing Systems	3	-	-	
Total Credits								12

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Professional Specialised Courses (PSC)								
SL. No	Semester	Course Category	Course Code	Name of the Course	Hours per week			Credit
					L	T	P	
1.	3	PSC		Sensors and Instrumentation	3	-	-	**3**
2.	3	PSC		Automatic Control Systems	3	-	-	**3**
3.	4	PSC		Robotics technology	3	-	-	**3**
4.	4	PSC		Programmable Logic Controllers	3	-	-	**3**
5.	5	PSC		Artificial intelligence Techniques	3	-	-	**3**
6.	6	PSC		Field and Service Robotics	3	-	-	**3**
7.	7	PSC		PLC and Robotics Laboratory	-	-	2	**2**
Total Credits								**20**

Project Mechanical Engineering courses (PROJ-ME)								
SL. No	Semester	Course Category	Course Code	Name of the Course	Hours per week			Credit
					L	T	P	
1	7	PROJ		Design and Fabrication Project	-	-	4	**2**
2	7	PROJ-ME		Industrial Internship and Training	-	-	-	**3**
3	8	PROJ-ME		Project Work	-	-	12	**10**
Total Credits								**15**

Open Electives Courses (OEC)								
SL. No	Semester	Course Category	Course Code	Name of the Course	Hours per week			Credit
					L	T	P	
1.	6	OEC - I		Cloud Computing	3	-	-	3
2.	6	OEC - I		Web Design	3	-	-	
3.	6	OEC - I		Digital Image Processing	3	-	-	
4.	6	OEC - I		Data Analysis	3	-	-	
5.	6	OEC - I		Astro-Physics	3	-	-	
6.	6	OEC - I		Business Administration	3	-	-	
7.	6	OEC - I		Chemistry in Crime Investigation	3	-	-	
8.	6	OEC - I		Bioinformatics	3	-	-	
9.	6	OEC - I		Finance for Non Finance Managers	3	-	-	
10.	6	OEC - I		Fuel Cell and Batteries	3	-	-	
11.	7	OEC - II		Autotronics	3	-	-	
12.	7	OEC - II		Artificial Intelligence & Machine Learning	3	-	-	
13.	7	OEC - II		Nano Technology & Surface Engineering	3	-	-	3
14.	7	OEC - II		Disaster Management & Mitigation	3	-	-	
15.	7	OEC - II		Robotics	3	-	-	
16.	7	OEC - II		HR Management	3	-	-	
17.	7	OEC - II		Nuclear and particle physics	3	-	-	
18.	7	OEC - II		Internet of Things (IOT)	3	-	-	
19.	7	OEC - II		Psychology	3	-	-	
20.	7	OEC - II		Statistical methods with excel	3	-	-	
21.	7	OEC - II		Key Board	3	-	-	
22.	7	OEC - II		Logistics and Supply Chain	3	-	-	
23.	7	OEC - II		Violin	3	-	-	
24.	7	OEC - II		Vocal Music	3	-	-	
Total Credits								**06**

B.E. (HONS.) MECHANICAL ENGINEERING WITH SPECIALIZATION IN ROBOTICS							
SEMESTER - I (First year)							
SL. No	**Course Category**	**Course Code**	**Name of the Course**	**Hours per week**			**Credit**
				L	**T**	**P**	
1.	BSC		Mathematics –I (Calculus & Linear Algebra)	3	1	-	**4**
2.	BSC		Engineering Chemistry	3	-	-	**3**
3.	ESC		Basic Electrical Engineering	3	-	-	**3**
4.	ESC		Engineering Graphics & Design	2	-	2	**3**
5.	BSC		Chemistry Lab	-	-	3	**2**
6.	ESC		Basic Electrical Engineering Lab	-	-	3	**2**
7.	MC*		English Proficiency Certification	2	-	-	**1***
* Not accountable for CGPA							
Total				**11**	**01**	**08**	**17+1***

SEMESTER - II (First year)							
SL. No	**Course Category**	**Course Code**	**Name of the Course**	**Hours per week**			**Credit**
				L	**T**	**P**	
1.	HSMC		English	2	1	-	**3**
2.	BSC		Mathematics – II (Calculus, Ordinary Differential Equations, and Complex Variables)	3	1	-	**4**
3.	BSC		Applied Physics for Engineers	3	-	-	**3**
4.	ESC		Programming for Problem Solving	2	1	-	**3**
5.	MC*		Environmental Science and Engineering*	2	-	-	**2***
6.	BSC		Physics Lab	-	-	3	**2**
7.	ESC		Programming for Problem Solving Lab	-	-	3	**2**
8.	ESC		Workshop/Manufacturing Practices Lab	-	-	3	**2**
* Not accountable for CGPA							
Total				**12**	**03**	**09**	**19+2***

SEMESTER - III (Second year)							
SL. No	Course Category	Course Code	Name of the Course	Hours per week			Credit
				L	T	P	
1.	BSC		Mathematics III (PDE, Probability & Statistics)	3	1	-	**4**
2.	ESC		Engineering Mechanics	2	1	-	**3**
3.	PCC		Fluid Mechanics & Machinery	2	1	-	**3**
4.	PCC		Thermodynamics	3	-	-	**3**
5.	PCC		Materials Engineering	3	-	-	**3**
6.	**PSC**		**Sensors and Instrumentation**	**3**	**-**	**-**	**3**
7.	**PSC**		**Automatic control system**	**3**	**-**	**-**	**3**
8.	PCC		Fluid Mechanics and Machinery Lab	-	-	3	**2**
9.	PCC		Materials and Metallurgy Lab	-	-	3	**2**
10.	MC*		Foreign Language Level – II and Above (German, French, Japanese, etc..,)	-	-	-	**1***
* Not accountable for CGPA							
Total				**19**	**03**	**06**	**26+1***

SEMESTER - IV (Second year)							
SL. No	Course Category	Course Code	Name of the Course	Hours per week			Credit
				L	T	P	
1.	ESC		Basic Electronics Engineering	3	-	-	**3**
2.	PCC		Applied Thermodynamics	3	-	-	**3**
3.	PCC		Strength of Materials	2	1	-	**3**
4.	PCC		Kinematics of Machines	2	1	-	**3**
5.	PCC		Manufacturing Processes	3	-	-	**3**
6.	**PSC**		**Robotics Technology**	**3**	**-**	**-**	**3**
7.	**PSC**		**Programmable logic controllers**	**3**	**-**	**-**	**3**
8.	MC*		Sanskrit and Indian Culture	2	-	-	**2***
9.	PCC		Thermal Engineering Lab	-	-	3	**2**
10.	PCC		Strength of Materials Lab	-	-	3	**2**
* Not accountable for CGPA							
Total				**21**	**02**	**06**	**25+2***

SEMESTER - V (Third year)							
SL. No	Course Category	Course Code	Name of the Course	Hours per week			Credit
				L	T	P	
1.	PCC		Heat and Mass Transfer	3	-	-	**3**
2.	PCC		Dynamics of Machines	2	1	-	**3**
3.	PCC		Instrumentation and Control	3	-	-	**3**
4.	PCC		Design of Machine Elements	3	-	-	**3**
5.	PCC		Manufacturing Technology	3	-	-	**3**
6.	PCC		Metrology and Quality Control	3	-	-	**3**
7.	**PSC**		**Artificial intelligence techniques**	**3**	**-**	**-**	**3**
8.	PCC		Machine Drawing Practical	-	-	3	**1**
9.	PCC		Manufacturing Technology Lab	-	-	3	**2**
10.	PCC		Dynamics and Measurements Lab	-	-	3	**1**
11.	MC*		Soft Skill and Aptitude Certification	-	-	-	**1***
* Not accountable for CGPA							
Total				**20**	**01**	**09**	**25+1***

SEMESTER - VI (Third year)							
SL. No	Course Category	Course Code	Name of the Course	Hours per week			Credit
				L	T	P	
1.	HSMC		Operation Research & Management	2	1	-	**3**
2.	PCC		Automobile Engineering	3	-	-	**3**
3.	PCC		Power Plant Engineering	3	-	-	**3**
4.	PCC		CAD/CAM	3	-	-	**3**
5.	**PSC**		**Field and service Robots**	**3**	**-**	**-**	**3**
6.	PEC		Professional Elective – I	3	-	-	**3**
7.	OEC		Open Elective – I	3	-	-	**3**
8.	PCC		Heat Transfer Lab	-	-	3	**2**
9.	PCC		CAD/CAM Lab	-	-	3	**2**
10.	MC**		Technical Certification Course	-	-	-	**1***
*Not accountable for CGPA							
Total				**20**	**01**	**06**	**25+1***

SEMESTER - VII (Fourth year)							
SL. No	**Course Category**	**Course Code**	**Name of the Course**	**Hours per week**			**Credit**
				L	**T**	**P**	
1.	PCC		Design of Transmission Systems	3	-	-	**3**
2.	PCC		Mechatronics	3	-	-	**3**
3.	PEC		Professional Elective – II	3	-	-	**3**
4.	PEC		Professional Elective – III	3	-	-	**3**
5.	OEC		Open Elective – II	3	-	-	**3**
6.	PCC		Computer Aided Analysis Lab	-	-	3	**2**
7.	PCC		Mechatronics Lab	-	-	3	**2**
8.	**PSC**		**PLC and Robotics laboratory**	**-**	**-**	**2**	**2**
9.	PROJ-ME		Design and Fabrication Project	-	-	4	**2**
10.	PROJ-ME		Industrial Internship and Training	-	-	-	**3**
11.	MC**		Presentation / Publication in Conference / Seminar	-	-	-	**1***
* Not accountable for CGPA							
Total Credits				**15**	**-**	**12**	**26+1***

SEMESTER - VIII (Fourth year)							
SL. No	**Course Category**	**Course Code**	**Name of the Course**	**Hours per week**			**Credit**
				L	**T**	**P**	
1.	PCC		Automation in Manufacturing	3	-	-	**3**
2.	HSMC		Engineering Economics	3	-	-	**3**
3.	PEC		Professional Elective – IV	3	-	-	**3**
4.	PROJ-ME		Project Work	-	-	12	**10**
5.	MC*		Start ups				**1***
* Not accountable for CGPA							
Total Credits				**09**	**-**	**12**	**19+1***

PROFESSIONAL ELECTIVE COURSES							
SL. No	Category	Code	Course Title	Hours per week			Credit
				L	T	P	
1.	PEC-I		Finite Element Analysis	3	-	-	3
2.			Fluid Power Systems				
3.			Product Design & Development				
4.			3D Printing				
5.			Tribology				
6.	PEC-II		Refrigeration & Air Conditioning	3	-	-	3
7.			I.C. Engines				
8.			Turbo Machines				
9.			Energy Conservation in Industries				
10.			Gas Dynamics & Jet Propulsion				
11.	PEC-III		Sustainable Manufacturing	3	-	-	3
12.			Design for Manufacturing				
13.			Theory of Metal Forming				
14.			Digital Manufacturing				
15.			Composite Materials				
16.	PEC-IV		Total Quality Management	3	-	-	3
17.			Entrepreneurship Development				
18.			Non-Traditional Machining Process				
19.			Non Destructive Evaluation				
20.			Flexible Manufacturing Systems				

OPEN ELECTIVE COURSES							
SL. No	Category	Code	Course Title	Hours per week			Credit
				L	T	P	
1.	OEC – I		Cloud Computing	3	-	-	3
2.			Web Design				
3.			Digital Image Processing				
4.			Data Analysis				
5.			Astro-Physics				
6.			Business Administration				
7.			Chemistry in Crime Investigation				
8.			Bioinformatics				
9.			Finance for Non Finance Managers				
10.			Fuel Cell and Batteries				
11.			Autotronics				
12.			Artificial Intelligence & Machine Learning				
13.	OEC - II		Nano Technology & Surface Engineering	3	-	-	3
14.			Disaster Management & Mitigation				
15.			Robotics				
16.			HR Management				
17.			Nuclear and particle physics				
18.			Internet of Things (IOT)				
19.			Psychology				
20.			Statistical methods with excel				
21.			Key Board				
22.			Logistics and Supply Chain				
23.			Violin				
24.			Vocal Music				

SEMESTER - III (Second year)

Course Title	SENSORS AND INSTRUMENTATION	Credits	L T P C
Course Code			3 0 0 3
Course Category			
Learning Level			

OBJECTIVES

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT–I INTRODUCTION

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT - II MOTION, PROXIMITY AND RANGING SENSORS

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

UNIT–III FORCE, MAGNETIC AND HEADING SENSORS

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT–IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors

UNIT–V SIGNAL CONDITIONING AND DAQ SYSTEMS

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

CO	COURSE OUTCOMES	PO
Upon completion of this course, Students should be able to		
1.	• Familiar with various calibration techniques and signal types for sensors.	
2.	• Apply the various sensors in the Automotive and Mechatronics applications	
3.	• Describe the working principle and characteristics of force, magnetic and heading sensors.	
4.	• Understand the basic principles of various pressure and temperature, smart sensors.	
5.	• Ability to implement the DAQ systems with different sensors for real time applications.	

TEXT BOOK	
1.	Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009 2.Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
REFERENCES	
1.	C. Sujatha . Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
2.	Hans Kurt Tönshoff (Editor), Ichiro , "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001. 3.John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3.	Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
4.	Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press,

Course Title	AUTOMATIC CONTROL SYSTEMS	Credits	L T P C
Course Code			3 0 0 3
Course Category			
Learning Level			

OBJECTIVES

- To study the basics of control system and its response. stability of mechanical and electrical systems. Use of MATLAB to design a stable control system.
- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response.
- To impart knowledge about the frequency response and the stability of systems
- To introduce the state variable analysis method

UNIT–I INTRODUCTION

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function - Modeling of physical systems – Mechanical, Thermal, Hydraulic systems and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor ,Potentiometer, Synchros, Tachogenerator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason‟ gain formula. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT - II TIME DOMAIN ANALYSIS

Standard Test signals – Time response of second order system - Time domain specifications - Types of systems - Steady state error constants - Introduction to P, PI and PID modes of feed back control. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT–III FREQUENCY DOMAIN ANALYSIS

Frequency domain specifications - Time and frequency response correlation – Polar plot – Bode plot – All pass minimum phase and non-minimum phase systems. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT–IV SYSTEM STABILITY

Characteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability - Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT–V ROOT LOCUS METHOD

Root locus concepts - Construction of root loci – Root contours. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions) STATE SPACE ANALYSIS: Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems - Introduction to state space representation using physical - Phase and canonical variables. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

CO	COURSE OUTCOMES	PO
Upon completion of this course, Students should be able to		
1.	• understand the basic of the control system	
2.	• know about the time and frequency domain analysis	
3.	• know about the different stability of the systems	
4.	• the state space representation and its analysis.	
5.	• introduce non-linear systems and their control and to impart knowledge on advanced control techniques	

SEMESTER - IV (Second year)

Course Title	ROBOTICS TECHNOLOGY	Credits	L T P C
Course Code			3 0 0 3
Course Category			
Learning Level			

OBJECTIVES

- To enlighten the students about the fundamentals of robotic systems.
- To impart knowledge about various drive systems and its selection for particular applications.
- To impart knowledge about kinematic and dynamic analysis of robot manipulators.
- To enlighten the students about the use of robot programming for various applications.
- To familiarize the students in the various applications of robot.

UNIT–I INTRODUCTION

History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical Grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

UNIT - II DRIVE SYSTEMS

Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT–III- KINEMATICS AND DYNAMICS OF ROBOTS

2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems.

Matrix representation, Forward and Reverse Kinematics of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.

UNIT–IV ROBOT CONTROL & PROGRAMMING

Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control.

Introduction to Robotic Programming, On-line and off-line programming, programming examples.

UNIT–V ROBOT APPLICATIONS

Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting.

CO	COURSE OUTCOMES	PO
Upon completion of this course, Students should be able to		
1.	• explain the fundamentals of robotic systems.	
2.	• describe about various drive systems and its selection for particular applications.	
3.	• explain about kinematic and dynamic analysis of robot manipulators.	
4.	• understand the significance and use of robot programming & control for various applications.	
5.	• familiarize the students in the various applications of robot.	
TEXT BOOK		
1.	Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, *"Technology Programming and Applications"*, McGraw Hill, 2012.	
REFERENCES		
1.	Deb .S.R, "*Robotics Technology and flexible automation*", Tata McGraw-Hill Education, 2010	
2.	Thomas R. Kurfess, Robotics and Automation Handbook. Ukraine, CRC Press, 2018.	
3.	Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, "*Robotics Engineering an Integrated Approach*", Phi Learning., 2009.	
4.	Janaki Raman .P.A, "*Robotics and Image Processing an Introduction*", Tata McGraw Hill Publishing company Ltd., 1995.	
5.	Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "*Robotics Control, Sensing, Vision and Intelligence*", McGraw Hill Book co, 1987.	

Course Title	PROGRAMMABLE LOGIC CONTROLLERS	Credits	L T P C
Course Code			3 0 0 3
Course Category			
Learning Level			

OBJECTIVES

- To know about the design of systems using PLC is introduced in detail.
- To know about the applications in PLC

UNIT–I INTRODUCTION TO FACTORY & PROCESS AUTOMATION

Industrial Versions - Control elements of Industrial Automation- IEC/ ISA Standards for Control Elements – Selection criteria for control elements- Construction of Relay Ladder logic with different control elements- Need for PLC - PLC evolution.

UNIT - II PROGRAMMABLE LOGIC CONTROLLERS

Architecture of PLC Types of PLC – PLC modules, PLC Configuration -Scan cycle - Capabilities of PLC- Selection criteria for PLC – PLC Communication with PC and software- PLC Wiring- Installation of PLC and its Modules.

UNIT–III PROGRAMMING OF PLC

Types of Programming – Bit Instructions -Timers and counters– PLC arithmetic functions PTO / PWM generation- High Speed Counter – Analog Scaling – Encoder Interfacing- Servo drive control – Stepper Motor Control

UNIT–IV HMI SYSTEMS

Need for HMI in Industrial Automation, Types of HMI – Configuration of HMI, Screen development and navigation, Configuration of HMI elements / objects and Interfacing with PLC

UNIT–V NETWORKING & APPLICATIONS OF PLC

PLC Networking- Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet - CAN Open.
Case studies of manufacturing automation and Process automation

CO	COURSE OUTCOMES	PO
Upon completion of this course, Students should be able to		
1.	learn about the design of systems using Programmable Logic Controllers	
2.	know about the different applications of Programmable Logic Controllers	

TEXT BOOK	
1.	W. Bolton, ―Programmable logic controllers‖, Elsevier Ltd, 2015.
2.	Frank D Petruzella, ―Programmable logic controllers‖, McGraw-Hill, 2011.
REFERENCES	
1.	John R Hackworth and Fredrick D Hackworth Jr., ―Programmable Logic Controllers: Programming Methods and Applications‖, Pearson Education, 2006.
2.	SIMATIC Programming with STEP 7, SIEMENS Manual, 2014.

SEMESTER - V (Third year)

Course Title	ARTIFICIAL INTELLIGENCE TECHNIQUES	Credits	L T P C
Course Code			3 0 0 3
Course Category			
Learning Level			

OBJECTIVES

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

UNIT–I INTRODUCTION

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

UNIT - II PLANNING

Planning with forward and backward State space search – Partial order planning – Planning graphs–Planning with propositional logic – Planning and acting in real world.

UNIT–III REASONING

Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT–IV LEARNING

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT–V AI IN ROBOTICS

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

CO	COURSE OUTCOMES	PO
Upon completion of this course, Students should be able to		
1.	Identify problems that are amenable to solution by AI methods.	
2.	Identify appropriate AI methods to solve a given problem.	
3.	Formalise a given problem in the language/framework of different AI methods.	
4.	Implement basic AI algorithms.	
5.	Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.	
TEXT BOOK		
1.	Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India2003.	
2.	Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison-Wesley, 2002.	
REFERENCES		
1.	David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.	

SEMESTER - VI (Third year)

Course Title	FIELD AND SERVICE ROBOTS	Credits	L T P C
Course Code			3 0 0 3
Course Category			
Learning Level			

OBJECTIVES

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

UNIT–I INTRODUCTION

History of service robotics – Present status and future trends – Need for service robots – applications examples and Specifications of service and field Robots. Non-conventional Industrial robots.

UNIT - II LOCALIZATION

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization Monte Carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

UNIT–III PLANNING AND NAVIGATION

Introduction-Path planning overview- Road map path planning- Cell decomposition path planning. Potential field path planning-Obstacle avoidance - Case studies: tiered robot architectures.

UNIT–IV FIELD ROBOTS

Ariel robots- Collision avoidance -Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

UNIT–V HUMANOIDS

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

CO	COURSE OUTCOMES	PO
Upon completion of this course, Students should be able to		
1.	Explain the basic concepts of working of robot	
2.	Analyze the function of sensors in the robot	
3.	Write program to use a robot for a typical application	
4.	Use Robots in different applications	
5.	Know about the humanoid robots.	
TEXT BOOK		
1.	Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2004	
2.	Riadh Siaer, "The future of Humanoid Robots- Research and applications", Intech Publications, 2012.	
REFERENCES		
1.	Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.	
2.	Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011	

SEMESTER - VII (Fourth year)

Course Title	PLC AND ROBOTICS LABORATORY	Credits	L T P C
Course Code			3 0 0 3
Course Category			
Learning Level			

OBJECTIVES

- To illustrate the design and simulation of multiple actuator systems using pneumatic, electropneumatic and PLCs and enable the students to integrate various fringe conditions in multiple actuator systems.
- To introduce different types of robotics and demonstrate them to identify different parts and components.
- To write programming for simple operations.

LIST OF EXPERIMENTS

1. Study of PLC field device interface modules (AI, AO, DI, DO modules)
2. Programming Logic Gates Function in PLC
3. Implementing Mathematical Operations in PLC
4. Programming Jump-to-subroutine and return operations in PLC
5. PLC Exercise: 1. Traffic Light Control and Filling/Draining Control Operation
6. Determination of maximum and minimum position of links.
7. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
8. Estimation of accuracy, repeatability and resolution.
9. Robot programming and simulation for pick and place
10. Robot programming and simulation for Colour identification

CO	COURSE OUTCOMES	PO
Upon completion of this course, Students should be able to		
1.	Ability to understand and Programming of PLC, SCADA and DCS	
2.	Ability to working with industrial automation system	
3.	Be able to design and implement control schemes in PLC and DCS	
4.	Ability to interface field devices with PLC and DCS	
5.	Use of any robotic simulation software to model the different types of robots and calculate work volume for different robots	