DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO. ACAD/NP/M.E./New Syllabi/190/2013

It is hereby informed to all concerned that, recommendation of the Faculty of Engineering and Technology, the Hon'ble Vice-Chancellor has accepted the ***"NEW Syllabi with Cumulative Grade Point Average [CGPA] for [1] M.E. [Manufacturing Process], [2] M.E. [Automation] and M.E. [CSE & IT]"*** on behalf of the **Academic Council Under Section-14(7) of the Maharashtra Universities Act, 1994** as appended herewith.

This is effective from the Academic Year 2013-2014 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO. ACAD/ NP/ M.E./
NEW SYLLABI / 2013/14101-09
V.C.14[7] A-08.

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Director,
Board of College and
University Development.

Date:- 15-06-2013.

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Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.
2] The Director, University Network & Information Centre, UNIC, with **a request to upload the above all syllabi on University Website [www.bamu.net].**

Copy to :-

1] The Controller of Examinations,
2] The Superintendent, [Engineering Unit],
3] The Programmer [Computer Unit-1] Examinations,
4] The Programmer [Computer Unit-2] Examinations,
5] The Superintendent, [Eligibility Unit] ,
6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,
Dr. Babasaheb Ambedkar Marathwada University,
7] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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S/150613/-*

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

New Syllabus of

M.E.

AUTOMATION

[Effective from the Academic Year 2013-14 & onwards]

Dr. Babasaheb Ambedkar Marathwada University Aurangabad.

Faculty of Engineering & Technology

Rules and Regulations for M.E. & M.Tech. -2014

- **What is a credit system**

  A credit system is a systematic way of describing an educational program by attaching credits to its components. The definition of credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours.

- **Advantages of the Credit System**
  - Represents a much-required shift in focus from teacher-centric to learner-centric education since the work load estimated is based on the investment of time in learning, not in teaching.
  - Helps to record course work and to document learner work load realistically since all activities are taken into account-not only the time learners spend in lectures or seminars but also the time they need for individual learning and the preparation of examinations etc.
  - Segments learning experience into calibrated units, which can be accumulated in order to gain and academic award.
  - Helps self-paced learning. Learners may undertake as many credits as they can cope with without having to repeat all the courses in a given semester if they fail in one or more courses. Alternatively, they can choose other courses and continue their studies.

- **What is Grading?**

  The word Grade derived from the Latin word gradus, meaning, step. Grading, in the educational context is a method of reporting the result of a learner's performance subsequent to his evaluation. It involves a set of alphabets which are clearly defined and designated and uniformly understood by all the stake holders. A properly introduced grading system not only provides for a comparison of the learner's performance but it

also indicate the quality of performance with respect to the amount of efforts put in and the amount of knowledge acquired at the end of the courses by the learners.

- **CURRICULUM:**

1.1 Curriculum:

Every program with specialization has a prescribed course structure which in general terms is known as Curriculum. It prescribes course to be studied in each semester; the relevant information containing course structure along with detail syllabus for each course of each program is updated periodically and is uploaded on the website.

1.2 Semesters:

The Faculty of Engineering & Technology implements a credit based curriculum and grade based evolution system for P.G. program is of four semesters. The academic courses are delivered in the first two semesters. Dissertation work is carried out by a student in the third and fourth semester. The first semester begins in the last week of July ends by the last week of November while the second semester begins in the first week of January and ends by the second week of May. Total duration for each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

1.3 Course Credit:

Education is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance/progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

A student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum grade point average is required to be maintained for satisfactory progress and continuation in the program. Also a minimum number of earned credits and a minimum grade point average should be acquired in order to qualify for the degree. All programmes are defined by the total credit requirement and a pattern of credit distribution over courses of different categories.

1.4 Course credits assignment

Each courses, except a few special courses, has a certain number of credits assigned to it depending upon its lecture, tutorial and laboratory contact hours in a week. This weightage is also indicative of the academic expectation that includes in-class contact and self-study outside of class hours.

Lectures and Tutorials: One lecture or tutorial hour per week per semester is assigned one credit.

Seminar/Contact Hours per week per semester is assigned one credit

Practical/Laboratory: One laboratory hour per week per semester is assigned half credit.

Example: Course: XYZ Engg: 3 credits (3-1-2)

The credits indicated for this course are computed as follows:

3 hours/week lectures = 3 credits

1 hours/week tutorial = 1 credit

2 hours/week practical = 2 x 0.5 = 1 credit

2 hours/week seminar = 2 x 0.5 = 1 credit

Dissertation seminar/Contact Hours = 1 x 1= 1 credit

(3-1-2) 3 credit course = (**3** h Lectures + **1** h Tutorial + **2** h Practical/Dissertation seminar) per week i.e. 6 Contact hours per week

1.5 Earning Credits

At the end of every course, a letter grade is awarded in each course for which a student had registered. On obtaining a pass grade, the student accumulates the course credits as earned credits. A student's performance is measured by the number of credits that he/she has earned and by the weighted grade point average.

The credit system enables continuous evaluation of a student's performance, and allows the students to progress at an optimum pace suited to individual ability and convenience, subject to fulfilling minimum requirement for continuation.

1.6 Evaluation System

1. Semester Grade Point Average (SGPA) =

   SUM (course credits in passed courses X earned grade points)

   SUM (Course credits in registered courses)

2. Cumulative Grade Point Average (CGPA) =

   SUM (course credits in passed courses X earned grade points) of all Semester
   ---
   SUM (Course credits in registered courses) of all Semester

3. At the end of M.E & M. Tech Program, student will be placed in any one of the divisions as detailed below.(According to AICTE Handbooks 2013-2014)

   Ist Division with distinction : CGPA $\geq$ 8.25 and above

   Ist Division : CGPA $\geq$ 6.75 and < 8.25

   IInd Division : CGPA $\geq$ 6.75 and < 6.25

As per AICTE Handbook (2013-14), new gradation suggested as follows,

Table 1

Grade Point	Equivalent Range
6.25	55%
6.75	60%
7.25	65%
7.75	70%
8.25	75%

Conversion of CGPA to percentage marks for CGPA $\geq$ 5.0 can be obtained using equations.

Percentage marks = (CGPA X10) – 7.5

An example of these calculations is given below:

Typically one example for academic performance calculations of semester –I

Table 2

Course No. (1)	Course Credit (2)	Grade Awards (3)	Earned Credit (4)	Grade Points (5)	Points Secured (6)=(4) x (5)
Subject 1	4	B	4	6	24
Subject 2	4	C	4	5	20
Subject 3	4	O	4	10	40
Subject 4	4	A+	4	8	32
Subject 5	4	C	4	5	20
Lab-1	2	A+	2	9	18
Lab-2	1	A+	1	9	9
Seminar-I	1	A+	1	9	9
Total	24		24	61	172

1. Semester Grade Point Average (SGPA) = $\frac{(172)}{(24)} = 7.16$

2. Cumulative Grade Point Average (CGPA) =
   Cumulative points earned in all passed courses = 172 (past semester) + 172 (this sem.) = 344

   Cumulative earned credits = 24 (past semesters) +24 (this sem) = 48

   $$\frac{\sum (172 + 172)}{\sum (24 + 24)} = 7.16$$

➢ **System Evaluation Table**

Table 3

Grade	Grade Points	Marks Obtained (%)	Description Performance
		Regular Semester	
O	10	91-100	Outstanding
A++	09	86-90	Excellent
A+	08	76-85	Very Good
A	07	66-75	Good
B	06	56-65	Fair
C	05	46-55	Average
D	04	40-45	Poor
F	00	Below 40	Fail
EE			Incomplete
WW			Withdrawal
XX	--	--	Detained
ABSENT	--	--	Absent
PP	--	--	Passed (Audit Course)
NP	--	--	Not Passed (Audit Course)

➢ **Grade Awards:**

i) A ten point rating scale shall be used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-4.

Table 4: Ten point grades and grade description

Sr.No.	Equivalent Percentage	Grade Points	Grade	Grade Description
1	90.00 – 100	10	O	Outstanding
2	80.00 – 89.99	9	A++	Excellent
3	70.00 – 79.99	8	A+	Exceptional
4	60.00 – 69.99	7	A	Very Good
5	55.00 – 59.99	6	B+	Good
6	50.00 – 54.99	55	B	Fair
7	45.00 – 49.99	5	C+	Average
8	40.01 – 44.99	4.5	C	Below Average
9	40	4.00	D	Pass
10	<40	0.00	F	Fail

ii) Non appearance in any examination/assessment shall be treated as the student have secured zero mark in that subject examination/assessment.

iii) Minimum D grade (4.00 grade points) shall be the limit to clear/pass the course/subject. A student with F grade will be considered as 'failed' in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations.

iv) Every student shall be awarded Grade points out of maximum 10 points in each subject (based on 10 Point Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and cumulative Grade card with CGPA will be given on completion of the course.

Proposed Coding System of M.E/M.Tech Subjects

Six Digit Code for a subject (PG Course)

	Digits →	1 2 3	4	5 6
Sr. No.	**Branch** ↓	**Branch code**	**Year**	**Subject**
1	Electronics	MEX	PG I year – 6	**Semester –I/III**
2	Electronics & Communication	MEC	PG II Year - 7	1-20 Theory
3	Electronics & Telecom.	MET		21-30 Practical
4	Digital Communication	MDC		31 Dissertation-I
5	Embedded System	MES		41-49 Electives
6	Structure Engineering	MSE		**Semester –II/IV**
7	Environmental Engineering	MEV		51-70 Theory
8	Water Resource Engineering	MWR		71-80 Practical
9	Computer Engineering	MCE		81 Dissertation-II
10	Computer Network	MCN		91-99 Electives
11	Software Engineering	MSW		
12	Mechanical Engineering	MME		
13	Thermal Engineering	MTE		
14	CAD/CAM	MCC		
15	Manufacturing	MMF		
16	Heat Power	MHP		
17	Design Engineering	MDE		
18	Machine Design	MMD		
19	Automation	MEA		
20	Chemical Engineering	MCH		
21	Computer & IT	MCI		
22	Production Process	MMP		
23	M.Tech Computer Science	MTC		
24	M.Tech Food Processing	MTF		
25	M.Tech Mechanical	MTM		

Note: - Kindly, Allot Same Code for same Electives/ subjects for different branches to avoid repetitions of Question papers/settings/assessments.

DEGREE OF MASTER OF ENGINEERING/TECHNOLOGY
(Course with effective from academic year: 2013-2014)

I	1	The examination for the Degree of Master of Engineering & Technology will be held in four semesters, M.E./M.Tech. Semester-I, M.E./M.Tech. Semester-II, M.E. ./M.Tech Semester-III, and M.E./M.Tech. Semester-IV in case of full time course. And for part time additional semester V & VI
II	**Rules & Eligibility**	
	1	Rule for admission to P.G. Degree course in Engineering and Technology as per rules and regulation of AICTE/DTE & Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
III	**Evaluation method**	
	1	Each theory course will be of 100 marks and be divided in to internal examination of 20 marks and semester examination of 80 marks (20+80=100 marks). Each practical course will be of 50/100 marks
	2	There shall be minimum two class tests within a semester. First based on 30% syllabus taught and second based on 30% syllabus taught. The setting of question paper and assessment will be done by the concerned teacher who has taught the syllabus. Average marks obtained out of two examinations will be considered for the preparation of final sectional marks/ grade.
	3	The Question papers in theory subjects shall be set by the Examiners appointed for the purpose by the University on the recommendations of the Board of studies of the concerned PG Course.
	4	The assessment of the Practical for any subject will be done by recognized post-graduate teacher appointed by University.
	5	To pass the examination a candidate must obtain a minimum CGPA of 6.25 (CGPA to the scale of 10).
	6	Candidate who secures CGPA $\geq$ 6.25 and CGPA < 6.75 declared to have passed examination in second class.
	7	Candidate who secures CGPA $\geq$ 6.75 and CGPA < 8.25 declared to have passed examination in first class.
	8	Candidate who secures CGPA $\geq$ 8.25 declared to have passed examination in

		first class with distinction.
IV	1	In case candidates fails to get less than D grade in one or more heads of passing examination, he will be allowed at his option, to reappear for only those heads of passing in which he has failed or got less than D grade at subsequent examinations.
	2	The grades obtained by the candidate in any head of passing at the examination will be carried forward unless the candidates reappear for the head of passing in accordance with ref. IV (1)
	3	In case the candidate passes in all heads of passing under M.E./M.Tech. Semester-I, M.E./M.Tech. Semester-II examination and obtained a minimum CGPA of 6.25 in M.E./M.Tech Semester-I, M.E./M.Tech Semester-II taken together as required under ref. II(2) above, he will not be allowed to reappear for any head of passing under M.E. Semester-I, M.E. Semester-II in accordance with ref. III(5)
	4	A candidate will not be allowed to appear for M.E. ./M.Tech Semester-III examination unless he passes in all heads of passing under M.E. ./M.Tech Semester-I, M.E./M.Tech Semester-II examination and obtains a minimum CGPA of 6.25.
	5	Whenever a candidate reappears for M.E. ./M.Tech Semester-III and M.E./M.Tech. Semester-IV examinations he will have to resubmit the dissertation with suitable modification and must also reappear for oral examination on it.
	6	A candidate registered for M.E./M.Tech Examination must clear his examination within five years from the date of registration.
V	**Attendance Requirement**	
	1	Each semester of the course shall be treated as a separate unit for calculation of the attendance
	2	A candidate shall be considered to have satisfied the attendance requirement if he/she has attended not less 75% of the class in each subject of all the semesters (Theory, Laboratory, Semester Practical training and Dissertation work) actually conducted up to the end of the semester.
	3	A Candidate, who does not satisfy the attendance required, mentioned as above, shall not be eligible to appear for the Examination of that semester and

		shall be required to repeat that semester along with regular students later.
	4	The Principal of the concerned College shall display regularly, the list of such candidates who fall short of attendance, on the Notice Boards.
	5	The list of the candidates falling short of attendance shall be sent to the University at least one week prior to the commencement of theory/practical examination, whichever is earlier.
VI	.	The following are the syllabi in the various subjects of the examination for the Degree of Master of Engineering/Technology.

Dr Babasaheb Ambedkar Marathwada University, Aurangabad

Proposed Syllabus Structure of M.E. (Automation) w.e.f. Academic Year 2013-14

Semester-I

Course Code	Name of the Subject	Contact Hrs/Week				Examination Scheme Marks and Credits						
		L	T	P	Total	Theory	Class Test	Term Work	Viva voce	Total	Duration of Theory Examination	Credits
MEA 601	Manufacturing Automation	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 602	Sensor Technology	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 603	Advanced Electrical Drives	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 604	Micro controller and its Applications	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 641	Elective - I	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 621	Sensors & Measurements Laboratory	-	-	2	2	-	-	50	-	50	-	1
MEA 622	Automation Lab-I	-	-	4	4	-	-	-	50	50	-	2
MEA 623	Seminar-I	-	-	2	2	-	-	-	50	50	-	1
Total of Semester - I		**15**	**5**	**8**	**28**	**400**	**100**	**50**	**100**	**650**		**24**

Semester-II

Course Code	Name of the Subject	Contact Hrs/Week				Examination Scheme Marks and Credits						
		L	T	P	Total	Theory	Class Test	Term Work	Viva voce	Total	Duration of Theory Examination	Credits
MEA 651	Control System Engineering	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 652	Robotics Engineering	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 653	Fluid Power Automation	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 654	Industrial Automation	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 691	Elective-II	3	1	-	4	80	20	-	-	100	3 Hrs	4
MEA 671	Mechatronics Laboratory	-	-	2	2	-	-	50	-	50	-	1
MEA 672	Automation Lab-II	-	-	4	4	-	-	-	50	50	-	2
MEA 673	Seminar-II	-	-	2	2	-	-	-	50	50	-	1
Total of Semester - II		**15**	**5**	**8**	**28**	**400**	**100**	**50**	**100**	**650**		**24**

Semester III

Course code	Name of the Subject	Teaching Scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MEA 731	Dissertation Phase I	--	12	12	--	50	50	100	12
	Total	**--**	**12**	**12**	**--**	**50**	**50**	**100**	**12**

Semester IV

Course code	Name of the Subject	Teaching scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MEA 781	Dissertation Phase II	--	20	20	--	100	200	300	20
	Total	--	**20**	**20**	--	**100**	**200**	**300**	**20**
	Grand Total							**1700**	**80**

Elective - I
Optimization Techniques
Automotive Electronics
Machine Tool Control and Monitoring

Elective - II
Artificial Intelligence and Expert Systems
MEMS and Nanotechnology
Computer Integrated Manufacturing

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week CH: Contact hours

Total Credits = SEM I + SEM II + SEM III + SEM IV
= 24 + 24 + 12 + 20
= 80

MEA 601. MANUFACTURING AUTOMATION

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. Introduction: **(6)**
Definition of automation, Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, 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.

2. Detroit-Type Automation: **(6)**
Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, 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.

3. Automation of Assembly Systems and Line Balancing: **(8)**
The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Computerized Line Balancing Methods, Other ways to improve the Line Balancing, Flexible Manual Assembly Lines. Automated Assembly Systems: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine.

4. Automated Materials Handling: **(6)**
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, Carousel Storage Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing.

5. Automated Materials Handling: **(6)**
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, Carousel Storage Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing.

6. Automated Inspection and Testing: **(8)**
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. Modeling Automated Manufacturing Systems: Role of Performance Modeling, Performance Measures, Performance Modeling Tools: Simulation Models, Analytical Models. The Future Automated Factory: Trends in Manufacturing, The Future Automated Factory, Human Workers in the Future Automated Factory, The social impact.

REFERENCES:

1. Automation, Production Systems and Computer Integrated Manufacturing, : Mikell P.Grover, Pearson Education Asia.
2. Robots and manufacturing Automation : C.Ray Asfahl, John Wiley and Sons New York.
3. Performance Modeling of Automated Manufacturing Syetms: N.Viswanadham and Y.Narahari, Prentice Hall India Pvt. Ltd.
4. Design of Automatic Machinary, Special Indian Edition: Stephen J. Derby, Marcel Decker, New York, Yesdee publishing Pvt. Ltd, Chennai

MEA 602. SENSOR TECHNOLOGY

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. Overview of measurement systems **(6)**

Measurement devices, Difference between sensor, transmitter and transducer; Smart device; Primary measuring element selection and characteristics: Range, Response time, Accuracy, Precision, Sensitivity, Dead band, Dead time, Costs, Installation Problems. Signal transmission: Types of signal: Pneumatic signal, Hydraulic signal, Electronic Signal. Standard signal ranges: Electronic transmitter adjusted range, Pneumatic transmitter adjusted range; Transmission system dynamics; transmission Lag, Transmitter Gain, Smart transmitters.

2. Principles of Sensors **(2)**

Classification of sensors, Characteristics and calibration of different sensors.

3. Displacement, position and motion sensors **(6)**

Principles of variable resistance, variable inductance, variable reluctance, variable capacitance type sensors. Position and Motion sensors: Limit switches, Proximity sensors, Pneumatic Proximity sensor, Optical Proximity sensor, Inductive Proximity sensor, Capacitive Proximity sensor, Ultrasonic Proximity sensor. LVDT: construction; Working principle, signal conditioning; use of LVDT, Tachogenerator: DC tachogenerator, Digital Tachogenerator, Optical type and magnetic type, Synchros and resolver, Encoders: types of encoder, Hall sensors: Working principle, Hall effect gear tooth sensor, Distance sensors, Light Sensor: Photovoltaic; Photoconductive (Photo resistors). Accelerometer : Definition, General Construction, Working Principle, Types of Accelerometer, Servo Type, Piezo Resistive Type, Capacitive Type, Variable reluctance type, Errors, Variable reluctance circuit Geometry, Auto null sensor amplifier, force balance servo sensor.

4. Force, Torque, Tactile **(6)**

Different types of load cells and its application, Piezoelectric transducer, Torque measurement: Tactile sensors: Types, construction and working principle of Tactile sensors. Magnetic, Piezoelectric, Photoelectric, capacitive and ultrasonic methods.

5. Strain Gauges

Working principle, construction, poisson's ratio, Gauge factor, Piezo resistance Coefficient, strain sensing alloys, characteristics, gauges length, rosettes, Types of Strain Gauge, Bonded, Unbonded, Metalic, Semiconductor, Strain Gauge Measurement: Wheatstone bridge measurement; Advantage between full bridge, half bridge and quarter bridge, disadvantage of bridge circuit, linearity error; lead error, bridge constant, temperature compensation, practical implementation of strain gauge (Installation method).

6. Pressure sensor **(6)**

Definition on pressure, static, head, dynamic pressure. Classification of pressure, Pressure Measurement method: Manometric, U Tube manometer, well type, inclined tube manometer, dead weight; electric strain method. Mechanical pressure measuring elements: Bourden tube: Types – C Type, Spiral, Helical, Twisted, Bellows, Diaphragm. Design and construction of different types of pressure sensing elements, Application of Diaphragm: Capacitance Type, Reluctance Type, Strain Gauge Type and Inductive Type. Application of Bellows: Differential pressure; Pneumatic Servo mechanism type. Electrical and Piezoelectric pressure transducers, McLeod gage, Pirani gage and Ionization gauge.

7. Flow sensors **(4)**

Reynolds number, principle of flow measurement, Types of Flow meter: Differential pressure type, positive displacement type, velocity type, mass meter type. Differential pressure type: orifices, venturi tubes, flow tubes, flow nozzles, pitot tubes, elbow-tap meters, target meters and variable area meters. Positive displacement type: Piston, Oval-gear, Rotary-vane types. Velocity meters: Turbine, Vortex shedding, Electromagnetic and Sonic designs. Mass meters : Coriolis and Thermal types. Head type flow meter, Electromagnetic flow meter, Rotameter, Anemometer, Ultrasonic flow meter.

8. Temperature sensor **(4)**

Mechanical and Resistance type temperature sensors, Thermocouples, Thermistor, Optical pyrometer.

9. Smart Sensor **(2)**

Methods of internal compensation, information coding, integrated sensor principles, present trends.

10. Sensors in Robotics **(4)**

Potentiometers, Synchros and Resolvers, Optical encoders, Tactile and Proximity sensors, Non-contact ranging sensors, Ultrasonic transducers, Opto-electric sensors, Geomagnetic sensors, Gyroscopes.

REFERENCES:

1. Electronic Measurements ; Cooper
2. Electronics Measurement : Olliver/ Cage
3. Principle of Industrial Instrumentation : Patranabis
4. A course in Electrical ,Electronic Measurement & instrumentation : A.K.Sawheney, Dhanpat Rai & Publications.
5. Instrument Engineers Handbook (Measurement): Liptak B.G, Chilton Book Co.1994.
6. Industrial Instrumentation : Eckman D.P. , Wiley Eastern Ltd.
7. Process control and Instrumentation : C.D Johnson

MEA 603. ADVANCED ELECTRICAL DRIVES

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. Introduction to Electrical Drives (6)
Electrical Drives, Parts of Electrical Drives, Dynamics of Electrical Drives, Components of Load Torques, Classification of Load Torques, Time and Energy-Loss in Transient Operations, Steady State Stability, Load Equalization.

2. Control of Electrical Drives (6)
Modes of Operation, Speed Control and Drive Classifications, Closed-Loop Control of Drives, Current-limit control, Closed-loop torque control, Closed-loop speed control, Closed-loop speed control of multi-motor drives, Speed sensing, Current sensing, Phase-locked-loop (PLL) control, Closed loop position control.

3. DC Motor Drives (6)
DC Motors and Their Performance, dc servo motors, Starting & Braking, Regenerative braking, Dynamic braking, Plugging, Speed Control, Transformer and Uncontrolled Rectifier Control, Controlled Rectifier Fed dc Drives, Single-phase fully-controlled and half-controlled, Three-phase fully-controlled and half-controlled rectifier control of dc motor, Dual-converter control of dc motor.

4. Induction Motor Drives (8)
Three-Phase Induction Motors, Analysis and performance, Starting, Soft start using saturable reactor starter, Braking, Starting and plugging, Speed Control, Rotor Resistance Control, Static rotor resistance control, Slip Power Recovery, Static Scherbius drive, Static Kramer drive, Variable Speed Constant Frequency, Squirrel-cage induction machine and Cycloconverter scheme, Wound-rotor induction motor and Cycloconverter scheme, Single-Phase Induction Motors: Starting, Breaking, Speed Control, PWM voltage source inverter (VSI) induction motor drives, Load commutated inverter fed synchronous motor drives, CSI squirrel-cage induction motor drive, PWM VSI squirrel-cage induction motor drive, Load commutated inverter (LCI) fed Induction motor drive.

5. Synchronous Motor (6)
Synchronous Motors, Starting, Braking, Synchronous Motor Variable Speed Drives, Variable frequency control, Modes of variable frequency control, Variable frequency control of multiple synchronous motors, Self-controlled synchronous motor drive employing load commutated thyristor inverter, Self-controlled synchronous motor drive employing a Cycloconverter.

6. Brushless dc Motor, Stepper Motor & Switched Reluctance Motor Drives (8)
Brushless dc Motors, Unipolar brushless dc motor, Bipolar brushless dc motor, Speed control of brushless dc motors, Important features and applications, Stepper (or Stepping) Motors, Variable reluctance, Permanent magnet important features of stepper motors, Torque versus stepping rate characteristics, Drive circuits for stepper motors, Switched Reluctance Motor. Servo Motor Drives: types of servo motor, closed loop position and speed control with servo motors.

REFERENCES:

(1)Thyristorised D.C. Drives : Sen P.C. – John Wiley & sons.
(2) Thyristor control of A S.C. Motors: Murphy J.M.D. & Turnbull F.G. – Pergamon press.
(3) Power Electronics & A.C. Drives : B.K.Bose - Prentice Hall Publication.
(4) Power Electronics : M.Rashid - Tata Mc GRAW Hill Publications.
(5) Power semiconductor Drives : Dubey G.K. - Prentice Hall Publication.
(6) Electric Drives : N.K.De and P.K.Sen - Prentice Hall Publication.

MEA 604. MICROCONTROLLER AND ITS APPLICATIONS

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. The 8051 Microcontrollers **(4)**
Introduction to computing, Microcontrollers and Embedded Controllers, Overview of 8051 family.

2. 8051 Assembly Language Programming **(8)**
Inside 8051, Introduction to 8051 assembly programming, assembling and running 8051 program, the program counter and ROM Space in 8051, Data Types and Directives, 8051 Flag Bits and the PSW Register, 8051 Register Banks and Stack, Loop and Jump Instructions, Call Instructions, Time Delay Generation and Calculation.

3. I/O PORT Programming and 8051 Addressing **(6)**
Pin Description of 8051, I/O Programming; Bit Manipulation, Immediate and Register Addressing Modes, Accessing Memory using Various Addressing Modes.

4. Arithmetic Instructions, Logic Instructions and Programs **(6)**
Unsigned Addition, Subtraction, Multiplication and Division Unsigned Number Concepts and Arithmetic Operations, Logic and Compare Instructions, Rotate and Swap Instructions, BCD and ASCII Application Programs

5. **Single Bit Instructions and Programming, Timer/ Counter Programming** **(4)**
Single Bit Instruction Programming, Single Bit Operations with CY, Reading Input Pins Vs. Port Latch, Programming Timers and Counter Programming

6. **8051 Serial Communication and Interrupts Programming** **(6)**
Basics of Serial Communication, 8051 Connection to RS 232, Serial Communication Programming, 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts and the Serial Communication Interrupt, Interrupt Priority in 8051

7. **Real World Interfacing** **(6)**
Interfacing an LCD, ADC, Sensors, Stepper Motor, Keyboard, DAC, Interfacing to External Memory, Memory Address Decoding, Interfacing with External ROM, Data Memory Space, Interfacing with 8255

REFERENCES:

1.The 8051 Micro controller and Embedded systems 3rd Indian reprint: M.A. Mazidi & J.G.Mazidi, Pearson Education
2.The 8051 Microcontroller : Kenneth J.Ayala
3. The 8051 Microcontroller : Mackenzie Publisher Pearson Education India
4.8051 Microcontroller : Rajkamal
5. Microcontrollers: Theory and Applications : Ajay V.Deshmukh

MEA 641-A. OPTIMIZATION TECHNIQUES

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. Introduction to optimization **(6)**
Engineering Applications, statement of an optimization problem, classification. Introduction to optimization techniques, Linear Programming: Simplex Method, Revised Simplex Method, Sensitivity Analysis.

2. Single Variable Optimization Problems **(10)**
Optimality Criterion; Bracketing Methods: Exhaustive search method, Bounding phase method; Region Elimination Methods: Interval Halving Method, Fibonacci Search Method, Golden Section Method; Point estimation methods: Successive Quadratic Estimation Method; Gradient Based Methods; Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method, Application to Root finding

3. Multivariable Optimization Algorithms **(10)**
Optimality Criteria, Unidirectional Search, Direct Search Methods: Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method, Gradient Based Methods: Cauchy's Steepest Descent Method, Newton's method, Marquardt's Method.

4. Constrained Optimization Algorithms **(6)**
Kuhn Tucker conditions, Transformation Methods: Penalty Function Method, Method of Multipliers (MOM), Sensitivity analysis, Direct search for constrained minimization:Variable elimination method, Complex search method.

5. Specialized algorithms: **(8)**
Integer programming, Introduction to Integer Programming; Cutting Plane Method; Branch and Bound method; Introduction to Genetic Algorithms, particle swarm Optimization, Geometric programming. Simulated Annealing (SA)

REFERENCES:

1. Optimization : Rao S S, Wiley Eastern, New Delhi, 1995.
2. Optimization for engineering design : Kalyanamoy Deb, Prentice Hall of India, New Delhi.
3. Operations Research: Principles and Practice : Ravindran, Phillips and Solberg, John Wiley & Sons (Asia), Pvt. Ltd.
4. Introductory Operations Research: Theory and Applications : H. S. Kasana and K. D. Kumar, Springer International Edition.
5. Optimization Concepts and Applications in Engineering : Belegundu,Wiley Students Edition.
6. Multi Objective Optimization Using Evolutionary Algorithms : Deb, Wiley Students Edition.
7. Practical Methods of Optimization : Fletcher, Wiley Students Edition.

MEA 641-B. AUTOMOTIVE ELECTRONICS

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. Fundamentals of Automotive Electronics. **(6)**
Introduction to Automobile Engineering, Automotive Engines, Automotive Control Systems - Components of Electronic Engine Management – Current trends in Automobiles.

2. Automotive Sensors and actuators. **(8)**
Introduction, basic sensor arrangement, types of sensors such as- oxygen sensors, crank angle position sensors- Fuel metering/ vehicle speed sensors, Attitude sensor, Flow sensor, exhaust temperature, air mass flow sensors,Throttle position sensor, Exhaust gas sensors – Engine knock, Engine torque sensors – Automotive actuators.

3. Automotive Engine control systems **(10)**
Introduction, Feedback carburetor systems (FBC), Throttle body injection and Multi port and point fuel injection, Fuel injection systems, injection system controls, Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less ignition systems, Electronic spark timing control.

4. Automotive Transmission Control Systems **(8)**
Transmission control – Cruise control – Braking control – Traction control – Suspension control – Steering control – Stability control – Integrated engine control.

5. Automotive monitoring and diagnostics **(8)**
Electromagnetic Interference (EMI) Suppression – Electromagnetic Compatibility – Electronic Dashboard Instruments – On board and off board Diagnostics – Security and warning Systems.

REFERENCES:

1. Understanding Automotive Electronics : William B. Riddens,5th Edition, Butterworth Hennimann Woburn, 1998.
2. Automotive Electrical Equipment : Young A.P. & Griffiths, ELBS & New Press-1999.
3. Automotive computers and control system : Tom Weather Jr. & Cland c. Ilunter, Prentice Hall Inc., New Jersey.
4. Automobile Electrical Equipment : Crouse W.H., Mc Graw Hill Co. Inc., New York ,1995.
5. Automotive Computers & Digital Instrumentation : Robert N. Brady, Prentice Hall, Eagle woods Cliffs, New jersey, 1988.
6. Understanding Automotive Electronic : Bechhold, SAE,1998.
7. Automotive Hand Book : Robert Bosch, SAE (5TH Edition),2000

MEA 641-C. MACHINE TOOL CONTROL AND CONDITION MONITORING

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. OVERVIEW OF AUTOMATIC CONTROL IN MACHINE TOOLS (8)
Open loop and closed loop system in machine tools- process model formulation transfer function-control actions-block diagram representation of mechanical pneumatic and electrical systems. Process computer - peripherals-Data logger-Direct digital control-Supervisory computer control.

2. DRIVE SYSTEMS AND FEED BACK DEVICES IN MACHINE TOOLS (8)
Hydraulic and Pneumatic drives, Electrical drives – A.C. Motor, D.C. Motor, Servo motor and Stepper motor. Feed back devices - Syncro, resolver, diffraction gratings, potentiometer, Inductosyn and encoders-application in machine tools.

3. ADAPTIVE CONTROL AND PLC (8)
Adaptive control-types – ACC, ACO, Real time parameter estimation, Applications - adaptive control for turning, milling, grinding and EDM. Programmable logic controller-Functions-Applications in machine tools.

4.VIBRATION, ACOUSTIC EMISSION / SOUND (8)
Primary & Secondary signals, Online and Off-line monitoring. Fundamentals of Vibration, Sound, Acoustic Emission. Machine Tool Condition Monitoring through Vibration, Sound, Acoustic Emission, Case Studies

5. CONDITION MONITORING, THROUGH OTHER TECHNIQUES (8)
Visual & temperature monitoring, Leakage monitoring, Lubricant monitoring, condition monitoring of Lube and Hydraulic systems, Thickness monitoring, Image processing techniques in condition monitoring.

REFERENCES:

1. Hand Book of Machine Tools : Manfred Weck, –Vol.3, John Wiley & Sons,1984.
2. Industrial Maintenance Management : Sushil Kumar Srivstava, S.Chand & Company Ltd., New Delhi, 1998.
3. Automation Production system and Computer Integrated Manufacturing : Mikell P.Groover, Prentice Hall of India Pvt. Ltd., 1995.

MEA 621. SENSORS AND MEASUREMENTS LABORATORY

Teaching Scheme
Practical: 2 hours/week
Credit: 1

Examination Scheme
Term work: 50 Marks

Term work
Performing following experiments and preparing record of experiments.

1. Calibration of flow meters.
2. Calibration of Thermocouples/ RTD.
3. Study of Load Cells.
4. Vibration measurement using accelerometers.
5. Displacement measurement/ level measurement.
6. Static and Dynamic response of Thermocouple/RTD
7. Analog/Digital signal conditioning circuit design for RTD/TC
8. Design and Characterization of Capacitive level sensor
9. Sensory system design for an application

MEA 622. AUTOMATION LAB- I

Teaching Scheme
Practical: 4 hours/week
Credit: 2

Examination Scheme
Viva voce: 50 Marks

Term work
Performing minimum 8 experiments out of the following and preparing record of experiments.

- Perform practicals on microcontroller.
- Perform practicals on AC / DC drives, stepper motor drives.
- Perform practicals on NC/ CNC programming.

The Practical Examination will consist of viva voce based on the syllabus and term work. The practical examination will be assessed by two examiners, one will be the subject teacher and other examiner appointed by Dr. B.A.M.U. Aurangabad.

ME 623. SEMINAR – I

Teaching Scheme
Practical: 2 hours/week
Credit: 1

Examination Scheme
Viva voce: 50 Marks

Seminar – I shall be based on the literature survey from sizeable number of publications on any topic, which will lead to dissertation in that area. It will be submitted as a report of about 30 pages. The candidate will have to deliver a seminar presentation before examiners, one of them will be the guide and other will be an examiner appointed by Dr. B.A.M.U. Aurangabad. The marks shall be awarded on the basis of performance of the individual student during his/her seminar presentation.

MEA 651. CONTROL SYSTEM ENGINEERING

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. SYSTEMS AND THEIR REPRESENTATION **(6)**
Basic elements in Control Systems – Mathematical Models – Mechanical translational – Mechanical rotational – Electrical systems – Transfer functions – Block diagrams, Reduction techniques – signal flow graph – Thermal – Hydraulic – Pneumatic Systems.

2. TIME AND FREQUENCY RESPONSE **(8)**
Time domain specifications-types of test inputs-I and II order systems-response generalized error series-steady state error-frequency domain specifications-polar plot- bode plot

3. STABILITY OF CONTROL SYSTEMS **(8)**
Characteristic equation-location of roots in S plane for stability – Routh's Hurwitz criterion-root locus technique construction-Gain and phase margin-Nyquist stability criterion.

4. STATE VARIABLE ANALYSIS AND DESIGN
Concepts of state variables and state model – state models for linear continuous – time systems – Solution of state equations – Concepts of controllability and observability – State variables and Linear Discrete – time systems – problems.

5. CONTROL SYSTEM COMPONENTS **(4)**
Servomotor-stepper motor- synchro -resolver- amplidyne - planar motor: types, principle, Application and Selection– Passive Compliances

6. RECENT TRENDS IN CONTROL SYSTEM **(6)**
Optimal control, Adaptive control –Classification of MRAC systems, self tuning regulator, Analysis and design of digital controllers, Inferential control, System identification, DMC & IMC algorithm, MIMO control systems.

7. PID CONTROLLERS **(8)**
On/off controller, continues controllers, P, I, D, PI, PD, PID actions, tuning of PID Controllers, self tuning controllers.

REFERENCES:
1. Modern controls engineering : K.Ogata, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2. Automatic Control Systems : B.C. Kuo, Prentice Hall of India Pvt. Ltd., New Delhi, 2004
3. Control system engineering : I.J.Nagrath and Gopal., New age international (P) Ltd., 2006.
4. Control Systems : A. Nagoor Kani, RBA publications (P) Ltd., 2007.
5. Control Systems priniciples and Design : M. Gopal,Tata MV Graw Hill Publishing Ltd, 2003
6. Control System Engineering : Norman Nise, Prentice Hall India, Fourth Edition

MEA 652. ROBOTICS ENGINEERING

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. Introduction (6)
History of robots, present and future trends in robotics, Repeatability, Control resolution, spatial resolution, precision, accuracy, Degrees of freedom of robots, Robot configurations, Work volume, Drives used in robots- Hydraulic, Pneumatic and Electric drives. Comparison of drive systems and their relative merits and demerits, Applications - Material handling - processing - Assembly and Inspection - safety considerations.

2. Transformations and Kinematics (8)
Vector operations - Translational transformations and Rotational transformations - Properties of transformation matrices-Homogeneous transformations and Manipulator - Forward solution - Inverse solution.

3. Controls And End Effectors (6)
Control system concepts - Analysis - control of joints - Adaptive and optimal control – End effectors - Classification - Mechanical - Magnetic -Vacuum - Adhesive - Drive systems - Force analysis and Gripper design.

4. Robot Sensors and Vision system (8)
Internal and external sensors, position- potentiometer, LVDT, optical sensors ,encoders - absolute, incremental, touch and slip sensors, velocity and acceleration sensors, proximity sensors, force & torque sensors, laser range finder, camera. Micro-controllers, Digital Signal Processing, centralized controllers, real time operating systems. Robot vision system: Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras, sensors, Camera and system interface, Frame buffers and Grabbers, Image processing.

5. Robot Controllers (6)
Essential components- mathematical model, transfer functions, Characteristic equation, types of controllers , Control System analysis and response, Drive for Hydraulic and Pneumatic actuators, H-bridge drives for Dc motor, Overload, over current and stall detection methods, example of a micro-controller/microprocessor based robot Controller

6. Robot Programming languages (6)
Introduction, robot programming methods, robot programming languages, Examples peculiar to robot programming languages, Artificial intelligence in robotics

REFERENCES:

1) Robotics Technology and Flexible Automation : S.R.Deb, Tata McGraw Hill
2) Industrial Robotics : M.P.Groover, M. Weiss R.N., McGraw", Hill 1996
3) Robotics : Control , sensors , vision and intelligence : K.S.Fu, R.C.Gonzalez and C.S.G.Lee, MCGraw-Hill.1987.
4)Introduction to Robotics:) J.J.Craig , Pearson Publications
5) Robotics Engineering: Klafter , Richard D., et al, PHI,1996.
6) Applying Machine Vision: Zuech,Nello, John Wiley and sons, 1988.
7) Robotics and Control : R K Mittal and I J Nagrath
8) Robot Dynamics and Control: Mark W Spong, et at, Wiley Publications
9) Introduction to Robotics, Analysis, Systems, Applications : Saeed B Niku , PHI.
10) Robotics: Yoram Koren, McGraw Hill 1992
11) Robotics and Image Processing: Janakiraman P.A., Tata McGraw Hill, 1995

MEA 653. FLUID POWER AUTOMATION

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. INTRODUCTION **(6)**
Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

2. FLUID POWER GENERATING/UTILIZING ELEMENTS **(8)**
Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation, accumulators – standard circuit symbols, circuit (flow) analysis.

3. CONTROL AND REGULATION ELEMENTS **(8)**
Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics-electro hydraulic servo valves-Different types characteristics and performance.

4.CIRCUIT DESIGN **(10)**
Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.

5.ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS **(8)**
Electrical control of pneumatic and hydraulic circuits- use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

REFERENCES:
1. Fluid Power Systems and control: Antony Esposito, Prentice-Hall, 1988
2. Hydraulic control systems: Herbert R. Merritt, John Wiley & Sons, Newyork, 1967
3. Basic Fluid Power: Dudbey.A.Peace, Prentice Hall Inc, 1967
4. Fluid Power logic circuit design: Peter Rohner, The Macmillan Press Ltd.,London, 1979
5. Introduction to fluid logic: E.C.Fitch and J.B.Suryaatmadyn, McGraw Hill, 1978.
6. Mechatronics, Electronic control systems in Mechanical and Electrical Engineering : W.Bolton, Pearson Education, 2003.
7. Fluid Power Logic Circuit Design : Peter Rohner, Mcmelan Prem, 1994.

MEA 654. INDUSTRIAL AUTOMATION

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. Automation strategy **(6)**

Introduction: Definition of automation, Types of production, Automation strategy, Need of automation in industry, Benefits of automation, Introduction of automation tools like PLC, DCS, SCADA, Hybrid DCS/PLC. Evolution of instrumentation and control, control system audit, performance criteria, development of user requirement specification (URS) for automation, Functional design specifications (FDS) for automation tools.

2. PLC **(8)**

Applications of PLC, PLC programming methods as per IEC 61131 , PLC applications for batch process and Process using SEC, Analog control using PLC, PLC interfacing to SCADA/DCS using communication links, Industrial Ethernet.

3. Distributed control systems **(8)**

Distributed control systems: DCS introduction, functions, advantages and limitations, DCS as an automation tool to support Enterprise resource planning, DCS component block diagram, Architecture of different makes, DCS Specifications, Latest trends and developments, performance criteria for DCS and other automation tools. SCADA specifications for different real time applications

4. Numerical control machines **(6)**

Fundamentals of numerical control including system concept, Design features of NC and CNC machines, Devices: drivers, servomechanism, tooling specifications, feedback components, positioning control, & countering pattern.

5. CNC **(8)**

CNC concepts, principle of operation of CNC, steps in manufacturing, construction features including drivers and structures, Advantages and limitations of CNC, axis of CNC machines, CNC programming using standard codes, use of subroutines, 2D and 3D integration and programming from CAD models and data banks, Multiple channel concepts, PLC selection, CNC selection guidelines Absolute and incremental encoders, Interface, concept of DNC.

6. Sourcing, sinking **(4)**

Sourcing, sinking of PNP/ NPN digital input, outputs, PLC scan, synchronous & asynchronous events, fast acting I/O modules, sequence logic, step logic, FCs, FBs concept.

REFERENCES:

1. The management of control system Justification & Technical auditing: N E Britinica, ISA
2. Computer Aided process control : S.K.Singh, Prentice Hall of India
3. Programmable Logic controllers : Webb & Ries, Prentice Hall of India
4. Introduction of PLC : Garry Dunning, Thomas learning
5. Distributed control systems for Industrial Automation :Popovik Bhatkar, Prentice Hall of India
6. Computer based process control : Krishna Kant, PHI India.
7. CAD/ CAM theory and practice : Ibraham Zaid
8. Computer aided mechanical design & analysis : Ramamurthy V.

MEA 691-A. ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1.Artificial Intelligence: Definition, Study of AI techniques, problems and Problems space, AI characteristics, Heuristics. Problem solving Methods: Forward and backward reasoning, problem trees, problem graph, hill climbing, search method, problem reduction, constraint satisfaction, means and analysis, game playing, mini max algorithms, alphabetic heuristics. **(8)**
2.Computer Vision: Perception, early processing, representation and recognition of scenes, Guzmans algorithms of spurting objects in a scene, Waltz algorithm. **(8)**
3. Neural Language understanding problems, syntactic analysis, semantic analysis, augmented transition networks. **(8)**
4.Knowledge representation (Logic): Representing facts in logic predicate logic, resolution, unification, question answering, mathematical theorem proving. Knowledge representation (Structured): Declarative representation, Semantic nets, procedural representation. **(8)**
5 Learning: Learning as induction, failure drive learning, learning by teaching, learning through examples (Winston"s program) skill acquisition. **(8)**

REFERENCES:

1. Artificial Intelligence : Elaine Rich, Mc Graw Hill, 1985.
2. Principles of Artificial Intelligence : Nilson
3. The Psychology of Computer : Winston
4. Introduction to Artificial Neural Systems : Jacek M. Zurada, Jaico Publishing House, 1994

MEA 691-B. MEMS AND NANO TECHNOLOGY

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. OVER VIEW OF MEMS AND MICROSYSTEMS **(6)**
Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication micro-system, microelectronics, working principle and applications of micro system.

2. MATERIALS, FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING
Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers. Photolithography, photo resist applications, light sources, in implantation, diffusion process exudation – thermal oxidation, silicon diode, chemical vapour deposition, sputtering - deposition by epitoxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level. **(10)**

3. MICRO DEVICES AND MATERIALS **(8)**
Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands displacement sensors, pressure and flow sensors, micro actuators – smart materials – applications.

4. SCIENCE OF NANO MATERIALS **(10)**
Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process.

5. CHARACTERIZATION OF NANO MATERIALS **(6)**
Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

REFERENCES:
1. MEMS and Microsystems Design and Manufacture: Tai – Ran Hsu, Tata-McGraw Hill
2. Fundamentals of Microfabrication : Mark Madou, CRC Press, New York, 1997.
3. Nano Technology: Norio Taniguchi, Oxford University Press, New York, 2003
4. The MEMS Hand book, Mohamed Gad-el-Hak, CRC Press, New York, London.
5. Introduction to Nano technology: Charles P Poole, Frank J Owens,John Wiley and Sons, 2003
6. Micro Sensors, Principles and Applications: Julian W. Hardner, CRC Press 1993.

MEA 691-C. COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme
Theory: 3 Hours/Week
Tutorial: 1 Hour/Week
Credit: 4

Examination Scheme
Class Test: 20 Marks
Theory: 80 Marks (3 Hrs.)

1. Introduction to CIM **(8)**

Basic Concepts of CIM: CIM Definition, Elements of CIM, CIM wheel, concept or technology, Evolution of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Fundamentals of Communication: Communications Matrix. Product Development Cycle, Concurrent Engineering: Definition, Sequential Engineering Versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of concurrent Engineering, Framework for integration of Life-cycle phases in CE, Concurrent Engineering Techniques, Integrated Product Development(IPD), Product Life-Cycle Management (PLM), Collaborative Product Development.

2. CIM database and database management systems **(8)**

Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language, Data Manipulation Language. Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

3. CIM Technology and Systems Product Design **(12)**

Needs of the market, Design and Engineering, The design Process, Design for Manufacturability (DFM): Component Design, Design for Assembly. Computer-Aided Process Planning: Basic Steps in developing a process plan, Variant and Generative Process Planning, Feature Recognition in Computer-Aided Process Planning. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP –II), Cellular Manufacturing: Design of Cellular Manufacturing Systems, Cell Formation Approaches: Machine–Component Group Analysis, Similarity Coefficients-Based Approaches. Evaluation of Cell Design. Shop-floor Control: Data Logging and Acquisition, Automated Data Collection, Programmable Logic Controllers, Sensor Technology. Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout; Operational Problems of FMS. FMS benefits.

4. Enterprise Wide Integration in CIM and CIM Models **(12)**

Introduction to Networking, Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration. CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM. UNIT – V Future Trends in Manufacturing Systems, Lean Manufacturing: Definition , Principles ,Characteristics & Benefits of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, Introduction to Agile and Web Based Manufacturing systems.

REFERENCES:

1. Principles of Computer Integrated Manufacturing: S.Kant Vajpayee, Printice-Hall India.
2. Systems Approach to Computer Integrated Design and Manufacturing : Nanua Singh, John Wiley.
3. CAD/CAM/CIM: P.Radhakrishnan, S.Subramanyam, New Age International
4. Computer Integrated Manufacturing: Alavudeen, Venkateshwaran, Printice-Hall India

MEA 671. MECHATRONICS LABORATORY

Teaching Scheme
Practical: 2 hours/week
Credit: 1

Examination Scheme
Term work: 50 Marks

Term work
Performing following experiments and preparing record of experiments.

1. Verification of P, P+I, P+D, P+I+D control actions.
2. Study of XY position control systems.
3. Study of linear conveyor control system.
4. Study of rotary table positioning systems.
5. Study of different switches and relays.
6. Analysis of control system using softwares.
7. Development of ladder diagram/programming PLC for level control, position control or any other mechanical engineering application.
8. Study of A/D and D/A converters.
9. Study of Flip Flops and Timers.
10. Study of Application of Op – Amp circuits.

MEA 672. Automation Lab. II

Teaching Scheme
Practical: 4 hours/week
Credit: 2

Examination Scheme
Viva voce: 50 Marks

Term work
Performing minimum 8 experiments out of the following and preparing record of experiments.

- Perform practicals on Robot – Programming /Drives /Motion simulation.
- Perform practicals on Pneumatic and Hydraulic actuators using trainer kits / Hydraulic and Pneumatic circuits using PLC.
- Perform practicals on Study of different control valves.

The Practical Examination will consist of viva voce based on the syllabus and term work. The practical examination will be assessed by two examiners, one will be the subject teacher and other examiner appointed by Dr. B.A.M.U. Aurangabad.

MEA 673. SEMINAR – II

Teaching Scheme
Practical: 2 hours/week
Credit: 1

Examination Scheme
Viva voce: 50 Marks

Seminar – II shall be based on the literature survey on any topic, (preferably in continuation with Seminar - I), which will lead to dissertation in that area. It will be submitted as a report of about 40 pages. The candidate will have to deliver a seminar presentation before examiners, one of them will be the guide and other will be an examiner appointed by Dr. B.A.M.U. Aurangabad. The marks shall be awarded on the basis of performance of the individual student during his/her seminar presentation.

MEA 731. DISSERTATION PART – I

Teaching Scheme
Contact hours: 12 hours/week
Credit: 12

Examination Scheme
Term work: 50 Marks
Viva voce: 50 Marks

The dissertation part - I shall include problem definition, literature survey, approaches for handling the problem, finalizing the methodology and design calculations/ experimental design etc for the dissertation work. A report of the work shall be submitted at the end of Semester III after approval by the Guide and endorsement of the Head of Department.

Term work:

The dissertation part – I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the University, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-voce:

The dissertation part – I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the University, one of whom will be the guide and other will be an external examiner.

MEA 781. DISSERTATION PART – II

Teaching Scheme
Contact hours: 20 hours/week
Credit: 20

Examination Scheme
Term work: 100 Marks
Viva voce: 200 Marks

The candidate shall submit the detailed report of the dissertation part - II work in the prescribed format after approval by the guide and endorsement by the Head of Department.

Term work:

The dissertation part – II will be in the form of seminar report on the project work carried by the candidate and will be assessed by two examiners appointed by the University, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-voce:

The dissertation part – II will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the University, one of whom will be the guide and other will be an external examiner.