University of Mumbai

No. AAMS_UGS/ICC/2022-23/ 175

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to the syllabus uploaded by Academic Authority Meetings & Services which was accepted by the Academic Council at its meeting held on 14th July, 2016 **vide** item No. 4.24 relating to the revised syllabus as per the (CBCS) for M.E. (Mechanical) CAD CAM and Robotics.

You are hereby informed that the recommendations made by the Board of Studies in **Mechanical Engineering** at its meeting held on 31st May, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 5th July, 2022 **vide** item No. 6.49 (R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 **vide** item No. 6.49 (R) and that in accordance therewith, the revised syllabus of **M.E. (CAD/CAM and Robotics) (Sem.- I to IV) (CBCS) (REV-2022 Scheme)**, has been brought into force with effect from the academic year 2022-23. (The circular is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
19th November, 2022

(Prof. Sunil Bhirud)
I/c Registrar

To
    The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.49 (R)/11/07/2022

Copy forwarded with Compliments for information to:-
1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Mechanical Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

Copy to :-
1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),
2. The Deputy Registrar, College Affiliations & Development Department (CAD),
3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),
4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),
5. The Deputy Registrar, Executive Authorities Section (EA),
6. The Deputy Registrar, PRO, Fort, (Publication Section),
7. The Deputy Registrar, (Special Cell),
8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,
9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

1. P.A to Hon'ble Vice-Chancellor,
2. P.A Pro-Vice-Chancellor,
3. P.A to Registrar,
4. All Deans of all Faculties,
5. P.A to Finance & Account Officers, (F.& A.O),
6. P.A to Director, Board of Examinations and Evaluation,
7. P.A to Director, Innovation, Incubation and Linkages,
8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),
9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,
10. The Director of Board of Student Development,
11. The Director, Department of Students Walfare (DSD),
12. All Deputy Registrar, Examination House,
13. The Deputy Registrars, Finance & Accounts Section,
14. The Assistant Registrar, Administrative sub-Campus Thane,
15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,
16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,
17. The Assistant Registrar, Constituent Colleges Unit,
18. BUCTU,
19. The Receptionist,
20. The Telephone Operator,
21. The Secretary MUASA

for information.

University of Mumbai

Revised Syllabus for

M.E.

(CAD / CAM and Robotics)

Semester – (Ito IV)

(Choice Based Credit System)

(With effect from the academic year 2022-23)

University of Mumbai

O: _____	Title of Course	M.E. (CAD CAM and Robotics)
O: _____	Eligibility	Ordinance 0.5134
R: _____	Passing Marks	45%
No. of years/Semesters:		4 semesters
Level:		P.G. / ~~U.G./ Diploma / Certificate~~
Pattern:		~~Yearly~~ / Semester
Status:		~~New~~ / Revised
To be implemented from Academic Year :		With effect from Academic Year : 2022-23

Dr. Vivek Sunnapwar
Chairman
of Board of Studies in Mechanical
Engineering

Dr. Suresh K. Ukarande
Associate Dean,
Faculty of Science and Technology

Dr Anuradha Majumdar
Dean,
Faculty of Science and
Technology

Preamble

Education in engineering is growing in India and is expected to increase by a factor of several in the near future. The current situation presents a significant challenge in terms of ensuring quality to stakeholders while expanding. To face this challenge, the problem of quality must be addressed, debated, and progressed in a methodical manner. Accreditation is the primary form of quality assurance in higher education, and it signifies that the institution or programme of study is committed to meeting certain minimum stated requirements and is available to external assessment in order to get recognition. The main goal of this accrediting procedure is to assess the outcomes of the programme being evaluated. Program outcomes are a collection of skills and information that a student will possess upon completion of the programme. In keeping with this, the University of Mumbai's Faculty of Science and Technology has taken the lead in implementing the principle of outcome-based education into the curriculum building process.

We are pleased to report that the Postgraduate Program Educational Objectives were completed in a brainstorming session attended by more than 20 members from the University's associated institutes. They were either department heads or senior faculty from the Mechanical Engineering Department. The Program Educational Objectives finalized for the postgraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.

2. To prepare the Learner to use modern tools effectively in order to solve real life problems.

3. To prepare the Learner for a successful career in Indian and Multinational Organisations

4. To encourage and motivate the Learner in the art of self-learning.

5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to the aforementioned, linked Institutes may add 2 to 3 additional programme instructional objectives of their own. In addition to Program Educational Objectives, each course in a postgraduate program's curriculum includes objectives and expected outcomes from the perspective of the learner to support the idea of outcome-based education. We are convinced that even a tiny move in the correct manner will go a long way toward ensuring that the main stakeholders receive high-quality education.

Dr. S. K. Ukarande	Dr Anuradha Muzumdar
Associate Dean	Dean
Faculty of Science and Technology	Faculty of Science and Technology
University of Mumbai	University of Mumbai

Preface

To tackle the challenge of assuring engineering education excellence, the problem of quality must be addressed, debated, and progressed in a methodical manner. Accreditation is the primary way of ensuring the quality of higher education. The main goal of the certification procedure is to determine how good a company is. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this, Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome-based education in the process of curriculum development.

Faculty of Science and Technology, University of Mumbai, in one of its meetings collectively resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs), give freedom to Affiliated Institutes to add few (PEOs), course objectives course outcomes to be clearly defined for each course, so that all faculty members in linked institutes are aware of the depth of approach to the subject to be given, so improving the learning process of students It was also decided that while changing the curriculum, the most senior academics from institutions and industry specialists should be included.

We are happy to state that the Board of studies has adhered to the resolutions passed by Faculty of Technology and developed curriculum accordingly. In addition to outcome-based education, Choice Based Credit System is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System allows for a much-needed shift in education focus from teacher-centric to learner-centric, since the workload estimate is based on time spent learning rather than teaching. It also emphasises constant evaluation, which will improve educational quality. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes. Faculty of Technology has devised a transparent credit assignment policy, adopting a ten-point scale to grade learner's performance. REV-2022 scheme is implemented for Master of Engineering from the academic year 2022-2023.

We trust this revised version of syllabus come up to the expectations of all stakeholders. We wish to place on record our sincere thanks and appreciations to the various contributors from the academia and industry for their most learned inputs in framing this syllabus.

Board of Studies in Mechanical Engineering

Dr. Vivek K. Sunnapwar   : Chairman
Dr. S. M. Khot   : Member
Dr. V. M. Phalle   : Member
Dr. Siddappa Bhusnoor   : Member
Dr. S.S. Pawar   : Member
Dr. Sanjay U. Bokade   : Member
Dr. Dhanraj Tambuskar   : Member
Dr. V. B. Tungikar   : Member
Dr. K.P. Karunakaran   : Member
Dr. S. S. Thipse   : Member
Dr. Milind Deshmukh   : Member

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CCC101	Computer Aided Design	3	--	--	3	--	--	3
CCC102	Mechatronics and Automation	3		--	3		--	3
CCPE101X	Program Elective 1	3	--	--	3	--	--	3
CCPE102X	Program Elective 2	3	--	--	3	--	--	3
CCIE101X	Institute Elective 1	3	--	--	3	--	--	3
CCL101	Program Lab-I **CAD and Computer Aided Engineering**	--	2	--	--	1	--	1
CCSBL101	Skill Based Lab-I **Simulation Based Optimization and Data Analytics**	--	4$^\$$	--	--	2	--	2
	Total	**15**	**06**	**--**	**15**	**03**	**--**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
CCC101	Computer Aided Design	20	20	20	80	3	--	--	100
CCC102	Mechatronics and Automation	20	20	20	80	3	--	--	100
CCPE101X	Program Elective 1	20	20	20	80	3	--	--	100
CCPE102X	Program Elective 2	20	20	20	80	3	--	--	100
CCIE101X	Institute Elective 1	20	20	20	80	3	--	--	100
CCL101	Program Lab-I **CAD and Computer Aided Engineering**	--	--	--	--	--	25	25	50
CCSBL101	Skill Based Lab-I **Simulation**	--	--	--	--	--	50	50	100

	Based Optimization and Data Analytics							
Total		--	--	100	400	--	75	75	650

Course Code	Program Elective 1 (CCPE101X)	Course Code	Program Elective 2 (CCPE102X)
CCPE1011	Artificial Intelligence and Expert System	CCPE1021	MEMS
CCPE1012	Smart Materials	CCPE1022	Optimization
CCPE1013	Simulation and Modelling	CCPE1023	Advanced Manufacturing Technology

Course Code	Institute Elective 1
	CCIE101X
CCIE1011	Product Lifecycle Management
CCIE1012	Reliability Engineering
CCIE1013	Management Information System
CCIE1014	Design of Experiments
CCIE1015	Operation Research
CCIE1016	Cyber Security and Laws
CCIE1017	Disaster Management and Mitigation Measures
CCIE1018	Energy Audit and Management

Semester II

Course Code	Course Name	Teaching Scheme(Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CCC201	Industrial Robotics	3	--	--	3	--	--	3
CCC202	Computer Aided Machining (CAM)	3		--	3		--	3
CCPE201X	Program Elective 3	3	--	--	3	--	--	3
CCPE202X	Program Elective 4	3	--	--	3	--	--	3
CCIE201X	Institute Elective 2	3	--	--	3	--	--	3
CCL201	Program Lab-II **CAM and Additive Manufacturing**	--	2	--	--	1	--	1
CCSBL201	Skill Based Lab-II **Mechatronics and Robotics**	--	4$^\$$	--	--	2	--	2
	Total	**15**	**06**	**--**	**15**	**03**	**--**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
CCC201	Industrial Robotics	20	20	20	80	3	--	--	100
CCC202	Computer Aided Machining (CAM)	20	20	20	80	3	--	--	100
CCPE201X	Program Elective 3	20	20	20	80	3	--	--	100
CCPE202X	Program Elective 4	20	20	20	80	3	--	--	100
CCIE201X	Institute Elective 2	20	20	20	80	3	--	--	100
CCL201	Program Lab-II **CAM and Additive Manufacturing**	--	--	--	--	--	25	25	50
CCSBL201	Skill Based Lab - II **Mechatronics and Robotics**	--	--	--	--	--	50	50	100
	Total	**--**	**--**	**100**	**400**	**--**	**75**	**75**	**650**

Course Code	Program Elective 3 (CCPE201X)	Course Code	Program Elective 4 (CCPE202X)
CCPE2011	Product Design	CCPE2021	Rapid Manufacturing
CCPE2012	Advanced Finite Element Analysis	CCPE2022	Sustainable Manufacturing
CCPE2013	Control Engineering	CCPE2023	Internet of Things (IOT)

Note 1: Skill Based Lab- I and II are focused on the learning through experience. SBL shall facilitate the learner to acquire the fundamentals of practical engineering in his or her specialization in a project-oriented environment. The learning through skill based labs can be useful in facilitating their research work and hence useful in early completion of their dissertation work.

Course Code	Institute Level Optional Course II CCIE201X
CCIE2011	Project Management
CCIE2012	Finance Management
CCIE2013	Entrepreneurship Development and Management
CCIE2014	Human Resource Management
CCIE2015	Professional Ethics and CSR
CCIE2016	Research Methodology
CCIE2017	IPR and Patenting/IP Management
CCIE2018	Digital Business Management
CCIE2019	Environmental Management

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CCMP301	Major Project: Dissertation -I	--	20	--	--	10	--	10
Total		**00**	**20**	**00**	**00**	**10**	**--**	**10**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
CCMP301	Major Project: Dissertation -I	--	--	--	--	--	100	--	100
Total		**--**	**--**	**--**	**--**	**--**	**100**	**--**	**100**

Online Credit Courses

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CCOCC301	Online Credit Course - I	--	--	--	--	--	--	3
CCOCC301	Online Credit Course - II	--	--	--	--	--	--	3
Total		**--**	**--**	**--**	**00**	**00**	**00**	**06**

Note 2: It is mandatory to complete the Online Credit Courses (OCC) available on NPTEL / Swayam /MOOC or similar platform approved by UoM. These two courses shall be completed in any semester I or II or III, but not later end of the Semester III. University shall make a provision that credits earned with OCC- I and OCC-II shall be accounted in the third semester grade-sheet with actual names of courses. The learner shall be allowed to take up these courses from his or her institute or organisation/ industry where his / her major project is carried out. The students shall complete the courses and shall qualify the exam conducted by the respective authorities/ instructor from the platform. The fees for any such courses and the corresponding examination shall be borne by the learner.

Online Credit Course – I
The learner shall opt for the course in the domain of Research Methodology **or** Research & Publication Ethicsor IPR. The opted course shall be of 3 credits of equivalent number of weeks.

Online Credit Course –II
The learner shall opt for the course recommended by Faculty Advisor/ Project Supervisor from the institute. The opted course shall be of 3 credits of equivalent number of weeks.

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CCMP401	Major Project: Dissertation -II	--	32	--	--	16	--	16
Total		**--**	**32**	**--**	**--**	**16**	**--**	**16**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
CCMP401	Major Project : Dissertation -II	--	--	--	--	--	100	100	200
Total		**--**	**--**	**--**	**--**	--	**100**	**100**	**200**

Total Credits: 68

Note 3: The Dissertation -II submission shall not be permitted till the learner completes all the requirements ME course.

Note 4: The contact hours for the calculation of load of the teacher for Major Project are as follows:
Major Project Dissertation I and II - 02 Hour / week / student

Guidelines for Dissertation-I

Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format. Guidelines for Assessment of Dissertation-I.

Dissertation-I should be assessed based on following points
- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization
- Clarity of objective and scope Dissertation-I should be assessed through a presentation by a panel of Internal examiners and external examiner appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

Dissertation II should be assessed based on following points:
- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization or current Research / Industrial trends
- Clarity of objective and scope
- Quality of work attempted or learner contribution
- Validation of results
- Quality of Written and Oral Presentation

Students should publish at least one paper based on the work in referred National/ International conference/Journal of repute.

Dissertation II should be assessed by internal and External Examiners appointed by the University of Mumbai.

Course Code	Course Name	Credits
CCC101	**Computer Aided Design**	**03**

Course Prerequisites:
1.   Linear Algebra – Basics of Matrix Multiplication and Coordinate Geometry

Objectives:
1.   Learn the rudiments of Computer Aided Design (CAD) and CAD systems.
2.   Use 3D modeling software to accurately generate and easily modify graphical representations of the product
3.   Enable the use of efficient product data management techniques.
4.   Enable the use of programming languages to program various algorithms for problem solving—related to generation of computer graphics and application to engineering design process.

Outcomes: Upon completion of the course, learner should be able to—
1. Integrate the role of graphic communication in the engineering design process.
2. Use algorithmic foundation for solving problems by writing computer programs.
3. Implement 2D and 3D transformations for positioning/shaping objects, or to change viewing positions, or even to change how something is viewed (e.g. perspective projections)
4. Formulate the parametric representation of standard conic shapes, 2D and 3D freeform curves and surfaces in the most efficient manner— required for creating complex profiles and geometries.
5. Describe various techniques of computer simulated reality i.e. virtual realism.

Module	Detailed content	Hours
1	Introduction to Computer Graphics: Definitions, Classification, Architecture of Interactive Computer Graphics, Applications Display &Interactive devices Scan Conversion: Pixel plotting, Scan Conversion of Line, Circle, Ellipse, Parabola, Hyperbola. Effects of Scan conversion Polygons: Types, Polygon filling using Boundary fill, edge fill, Flood fill algorithms, Scan conversion with Real Time scan conversion, Run length	6
2	Object Transformations: 2D & 3D (Translation, Rotation, Reflection, Scaling, Shearing); Homogeneous Coordinates, Decomposition of combined transformation matrix into basic transformation matrices (limited to three) taken in order	8
3	2-D Viewing & Clipping, 3D Viewing & Clipping Projections: Parallel &Perspective Projections	6
4	Curves: Spline curve, Bezier curve, DeCasteljau Algorithm for generating Bezier curves (limited to cubic curves), B-Spline curve, NURBS curve Surfaces: Hermite, Bezier & B-Spline surfaces	6
5	Virtual Reality: Hidden Lines &Hidden Surfaces: Z-Buffer, Painters, Area-Subdivision, Scan Line algorithm Light, Color&Shading Models, Animation	5

6	CAD &Geometric Modeling: Features of Modeling& Assembly Packages, Types of Geometric Modeling, Data Structures, Product Data Exchange Formats. Fundamentals of CAE: General procedures of Numerical methods like FEM & FDM, Kinematic Analysis & Animation, Features and Application of FEM.	5

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1.   Question paper will comprise of total six question
2.   All question carry equal marks
3.   Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4.   Only Four questions need to be solved.

References:

1.   Computer Graphics –F.S Hill. Jr
2.   Computer Graphics—Zhigang Xiang & Roy Plastock (Schaum's Outlines)
3.   Computer Graphics—Hearn & Baker
4.   Mathematical Elements for Computer Graphics—David F. Rogers, James Alan Adams
5.   Procedural Elements for Computer Graphics—David F. Rogers, James Alan Adams
6.   Mastering CAD/CAM—Ibrahim Zeid 7.Geometric Modelling—Mortenson, M.E.
8.   Computer Graphics—Amarendra Sinha, ArunUdai
9.   Fundamentals of Computer Graphics—Peter Shirley
10.   CAD/CAM - Theory and Practice—Ibrahim Zeid, R Sivasubramanian
11.   CAD/CAM—Mikell Groover, Emory Zimmers Jr.
12.   CAD CAM - Principles, Practice, and Manufacturing Management—Chris McMahon, Jimmie Browne
13.   Curves and Surfaces in Computer Aided Geometric Design—Fujio Yamaguchi
14.   Computer Graphics – Principles & Practice—Foley, van Dam, Feiner, Hughes
15.   Computer Aided Engineering Design—Anupam Saxena, Birendra Sahay

Course Code	Course Name	Credits
CCC102	**Mechatronics and Automation**	**03**

Objectives:
1. To Familiarize with the basic concepts of Automation and Mechatronics
2. To acquaint with the Concept of Design of pneumatic and Hydraulic system
3. To acquaint with the mechanisms of physical devices with Electronics, Electrical and Information systems to problems and Challenges in the areas of Mechatronics
4. Acquire knowledge of mechatronics in the field of product Design, Development and Manufacturing

Outcomes: Upon completion of the course, learner should be able to—
1. Demonstrate the use of Low-cost automation
2. Design of pneumatic and hydraulic system
3. Understand mechatronics components for a given application
4. Demonstrate team-oriented Skills within the field of mechatronics

Module	Detailed content	Hours
1	Definition; Automation in production systems; Automation principles and strategies; Levels of automation; Types of automation; Benefits and Impact of Automation on Manufacturing and Process Industries. Traditional and Mechatronics design, Mechatronics Key elements, Basic Components of Mechatronics Systems, Integrated design issues in Mechatronics, Mechatronics Design process, Mechatronics System in Factory, Home and Business Applications, Objectives, Advantages and Disadvantages of Mechatronics.	6
2	**Overview of Sensors and Transducers** - Sensors for motion and position, Force Torque and Tactile Sensors, Range Sensors, Proximity Sensors, Ultrasonic Sensors. Interfacing of sensors with micro-computer system. Micro and Nano Sensors in Mechatronics.	6
3	**Pneumatic Circuit Design** : Types of Actuators , Direction Control Valves, , flow and pressure control valves, Timer. Cascading and Shift Register Circuit Upto 3 Cylinders. Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping; Design of Pneumatic circuits using PLC Control (ladder programming only) up to 2 cylinders, with applications of Timers and Counters and concept of Flag and latching.	8
4	**Overview of Micro-processors and Micro-controllers** - 8051 Micro-controllers, Functional Block diagram and Architecture, Instruction set and Assembly Language Programming.	6

5	**Interfacing hardware with real world** - Analog Interface and Data acquisition, Digital I/O interfacing, special function interfacing, signal conditioning, special utility support hardware Interfacing of: HEX-keyboards, LCD display, ADC, DAC and stepper motor with 8051 Micro controller.	6
6	**Case Studies of Mechatronics Systems** - Timed Switch, Pick and Place Robot, Car Park Barrier, Automatic Camera, Car Engine Management, Bar Code System, CNC Machine, ABS, Artificial Intelligence in Mechatronics, Fuzzy Logic applications in Mechatronics.	4

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Joji P, Pneumatic Controls, Wiley India PVT. Ltd, 2008
2. Peter Croser, Frank Ebel, Pneumatics Basic Level, Festo Didactic GMbH& Co. Germany.
3. Prede G, Scholz D, Electro-pneumatics Basic level, Festo DidacicGmbh& Co. Germany
4. The 8051 microcontroller Architecture, Programming and Applications Kenneth J T Ayala, Pemam International Publishing, (India).
5. The 8051 microcontroller and embedded systems using assembly and C by M.A. Mazidi, J. Mazidi and R. D. McKinlay. PHI, second edition
6. Mechatronics. HMT

CourseCode	CourseName	Credits
CCPE1011	**ArtificialIntelligenceandExpertSystems**	**03**

Objectives:

1. ToUnderstandandexplainthebasicknowledgerepresentation,problemsolving,andlearningmethodsofArtificialIntelligenceandexpertsystem.
2. ToAssesstheapplicability,strengths,andweaknessesofthebasicknowledgerepresentation,problemsolving,andlearningmethodsinsolvingparticularengineeringproblems
3. ToequipstudentswiththetoolstotacklenewAIparadigm,developaninterestinthefieldsufficienttotakemoreadvancedsubjects.
4. Todevelopintelligentsystemsbyassemblingsolutionstoconcretecomputationalproblems.

Outcomes: Learnerwillbeableto…

1. Understandknowledgebase,searchmethods,heuristicandstatespacemethodsetc,.
2. Understand/Simulate/imitateanintelligenthumanbeing,intermsofconversation.
3. Understandartificialintelligence,problemsolving,intelligentagents,expertsystems,searchtechniques.
4. Developapieceofsoftwarewhichisabletoprocessnaturallanguage,knowledgerepresentation.

Module	DetailedContents	Hours
01	**AIandInternalRepresentation:**Introduction,definitions-Turingapproach,Cognitivemodelingapproach,Lawsofthoughtapproach,Therationalagentapproach,FoundationsofAI(history). **IntelligentAgents:**ConceptofRationalAgent,StructureofIntelligentagents,agentprogram,Examples.Simplereflexagent,Goalbasedagent,Utilitybasedagent,AgentEnvironments**,**environmentprograms,Examples.**ProblemSolving:**Solvingproblemsbysearching,ProblemFormulation,SearchStrategies,UninformedSearchTechniques,DFS,BFS,Uniformcostsearch,IterativeDeepening,ComparingdifferentTechniques, Informedsearchmethods–BestFirstSearch,heuristicfunctions,Hill-Climbing,A*.IDA*.CryptArithmetic.	06
02	**Game playing**:Perfect decisions in two person games, Imperfect decisions,Alpha-betapruning,Gameswithelementofchance. **Knowledgebasedagent,**WUMPUSsimpleenvironmentalclassgame,knowledgerepresentations,reasoningandlogic,prepositionallogic,AgentforWUMPUS,translatingknowledgeintoaction,problemswithprepositionalagent.Firstorderlogics,(syntaxandsemantics),logicalagentforWUMPUS,simplereflexagent,Representingchangeintheworld,situationcalculus,frameproblemsandrelatives.Basicrepresentationsforplanning,situationstateandplan,representationforplans,practicalplanning.	06

03	**ExpertSystems:**Characteristics,capabilities,components,limitations,applications with respect to manufacturing and mechanical engineering (case studies).Expertsystemtechnologiesanditsbenefits. **ProgramminginLISPorPROLOG:**Lisps,TypingatLisp,DefiningPrograms, Basic Flow of Control in Lisp, Lisp Style, Atoms and Lists, BasicDebugging,BuildingUpListStructure,MoreonPredicates,Properties,Pointers,CellNotationandtheInternals(Almost)ofLisp,DestructiveModificationofLists,TheforFunction,Recursion,ScopeofVariablesInput/output,Macros.Datawarehousing&DataMining.OnlineAnalytic Processing[OLAP]:itsarchitectureandisuse.Javaimplementations.	**06**
04	**FundamentalsConceptsandModelsofArtificialNeuralSystems:**BiologicalNeuronandtheirArtificialModels,ModelsofANN,Learningand Adaptation, Neural Networking Learning Rules. Single-layer PerceptionClassifiers. **MultilayerFeedforwardNetworks:**LinearlyNon-separablePattern Classification,DeltaLearningRule,FeedforwardRecallandErrorBack-PropagationTraining,LearningFactor	
05	**Uncertainty:** uncertainty, representation of knowledge in uncertain domain,semanticsofbeliefnetwork,Representingignorance-Dempster-shafertheory. **Representingvagueness**:Fuzzysetsandfuzzylogics,FuzzyRelations,FuzzyFunction,FuzzyMeasures,Probabilities&possibilities.FuzzyModelingandapplicationsofFuzzyControl,NeuralandfuzzymachineIntelligence.Representingdecisionproblems,Usingdecisionnetworks, makingsimpledecisionandcomplexdecision.	
06	**GeneticAlgorithm:**Simplegeneticalgorithm,Simulationbyhands,similaritytemplates(Schemata),Mathematicalfoundations,SchemaProcessingatwork.Thetwo-armedandk-armedBanditProblem,Thebuildingblockhypothesis,TheminimalDeceptiveProblem. ComputerimplementationofGeneticalgorithm,DataStructures,Reproduction,CrossoverandMutation.TimetoreproduceandtimetoCrossMapping,Objectivefunctiontofitness,form,Fitnessscaling.Applicationsofgeneticalgorithm,De-JongandFunctionOptimization,Improvementinbasictechniques.IntroductiontoGeneticsbasedmachineLearningitsapplications.	

Assessment:

Internal:

Assessmentconsistsoftwotestsoutofwhich;oneshouldbecompulsoryclasstest**(onminimumTwoModules)**andtheotheriseitheraclasstestorassignmentonliveproblemsorcourseproject.

EndSemesterTheoryExamination:

Someguidelinesforsettingupthequestionpaper.Minimum 80%syllabusshouldbecoveredinquestion papers of end semester examination. **In question paper weightage of each module will beproportionaltonumberofrespectivelecturehoursasmentioninthesyllabus.**

1. Questionpaperwillcompriseoftotalsixquestion
2. Allquestioncarryequalmarks

3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 thenpart(b)willbefromanymodule otherthanmodule 3)
4. OnlyFourquestionsneedtobesolved.

References:

1. ArtificialIntelligence,AmodernapproachByStaurtJRusselandPeterNorvig,byPrenticeHallInc,1995.NewJersey.
2. IntroductiontoArtificialintelligenceByEugeneCharniak,DrewMcDermottAddisonWesleyArtificialNeuralNetworks-B.Yegnanarayana,PHI,1999.
3. GeneticAlgorithmsinsearch,Optimization&MachineLearningbyDavidEGoldberg-AddisonWesley
4. DataMiningbyPieterAdriaansandDoltZantinge-PearsonEducationAsia
5. DataWarehousingintheRealWorldbySamAnahoryandDennisMurray.

Course Code	Course Name	Credits
CCPE1012	**Smart Materials**	**03**

Objectives
1. To study the working principles of various smart materials.
2. To identify applicability of various smart materials as actuator and sensor.
3. To study advances in smart materials

Outcomes: Learner will be able to…
1. Understand working of smart materials and their application as actuator and sensor.
2. Select an appropriate smart material for a given application.
3. Identify applicability of smart materials for new prospective smart structures

Module	Detailed Contents	Hours
01	**Introduction to Smart Materials:** Overview of the different types of Smart Materials, Smart materials used in structures, smart material for sensors, actuators controls, memory and energy storage and their inter-relationships.	**06**
02	**Important Concepts of Smart Materials:** Artificial skins, Artificial muscles, Biomimetic materials, materials with tunable responses, non-linear properties, self-healing materials, adaptive structures, self-replicating materials/structures, self-assembly, inch worm devices, hysteresis, integrated sensing and actuation.	**08**
03	**Overview of the following materials** with focus on synthesis, constitutive / governing relationships, strengths and weaknesses, and applications. 1. Piezoelectric Materials 2. Magnetostrictive Materials 3. Shape Memory Alloys 4. Electroactive Polymers	**08**
04	**Overview of the following materials** with focus on synthesis, strengths and weaknesses, and applications. 1. Ferrofluids and Magneto rheological Fluids and applications in dampers 2. Soft Matter and its applications as smart skins, smart textiles etc 3. Carbon Nanotubes and Carbon nano-structures and its applications 4. Thermoelectric Materials and Peltier devices	**06**
05	**Smart Materials for Energy Applications:** Materials used for energy storage, Hydrogen Storage Materials, Energy harvesting, Energy scavenging from vibrations.	**04**
06	**Composite Materials:** Introduction to Composite Materials, Nano Composite Materials, Soft conducting and magnetic solids, active fiber composites, Self-heating cement/ polymer matrix composites.	**04**

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. M.V. Gandhi and B.S. Thompson, "Smart Materials and Structures", Chapman & Hall, London; New York, 1992 (ISBN: 0412370107)
2. Mel Scwartz, "Encyclopedia of Smart Materials Vol. I and II", John Wiley & Sons
3. SenolUtku, "Theory of Adaptive Structures : Incorporating Intelligence into Engineered Products", CRC Press
4. A.V. Srinivasan, "Smart Structures: Analysis and Design", Cambridge University Press,Cambridge;
   New York, 2001 (ISBN: 0521650267)
5. G. Gautschi, "Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission
   Sensors, Materials and Amplifiers", Springer, Berlin; New York, 2002 (ISBN:3540422595)
6. K. Uchino, "Piezoelectric Actuators and Ultrasonic Motors", Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114)
7. G. Engdahl, "Handbook of Giant Magnetostrictive Materials", Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012 238640X)
8. K. Otsuka and C.M. Wayman, "Shape Memory Materials", Cambridge University Press, Cambridge; New York, 1998 (ISBN: 052144487X)
9. Eric Udd, "Fiber Optic Sensors: An Introduction for Engineers and Scientists", John Wiley &Sons, New York, 1991 (ISBN: 0471830070)
10. André Preumont, "Vibration Control of Active Structures: An Introduction", 2nd Edition, Kluwer Academic Publishers, Dordrecht; Boston, 2002 (ISBN: 1402004966)
11. HojjatAdeli, "Control, Optimization, and Smart Structures: High-Performance Bridges and Buildings of the Future", John Wiley, New York, 1999 (ISBN: 047135094X)
12. T.T. Soong, "Passive Energy Dissipation Systems in Structural Engineering", Wiley, Chichester; New York, 1997 (ISBN: 0471968218)
13. V.K. Wadhawan, *Smart Structures: Blurring the Distinction Between the Living and Nonliving,* Oxford University Press, Oxford (2007)
14. H.T. Banks, R.C. Smith and Y Wang, "*Smart Structures: Modeling, Estimation and Control*", Wiley, New York (1996)
15. *Shape Memory Alloys*, (ed) D.C. Lagoudas, Springer Science (2008)
16. S.K. Ghosh , "*Self-healing Materials: Fundamentals, Design Strategies and Applications,* Wiley-VCH Verlag GmbH and Co. (2009)
17. Kwang J Kim and Satoshi Tadokore, *"Electroactive Polymers for Robotic Applications: Artificial Muscles and Sensors*", Springer-Verlag, London (2007)
18. S Priya and D J Inman, "*Energy Harvesting Technologies*", Springer-Verlag (2008)
19. MoriakiWakaki, "*Optical Materials and Applications*", CRC Press (2012)
20. S.S. Ray and M Bousmina, "*Polymer Nanocomposites and their Applications*", American Scientific Publishers (2008)

Course Code	Course Name	Credits
CCPE1013	**Simulation and Modelling**	**03**

Objectives
1. The primary objective of this course is to provide an insight into how simulation modeling can aid in effective decision-making.
2. It provides students with the basic system concept and definitions of system techniques to model and to simulate various systems, the ability to analyze a system and to make use of the information to improve the performance.

Outcomes: Learner will be able to,
1. Understand the system concept and apply functional modeling method to model the activities of a static system;
2. Simulate the operation of a system and make improvement according to the simulation results.

Module	Detailed content	Hours
1	**Principle of computer modelling and simulation:** Monte Carlo simulation. Nature of computer- modeling and simulation. Limitations of simulation, areas of applications. Components of a system - discrete and continuous systems, Models of a system -a variety of modeling Approaches.	04
2	**Discrete Event Formalisms** Concepts of discrete event simulation, model components, a discrete event system simulation, simulation world views or formalisms. Characteristics of queueing systems, queueing notations, long run measures of performance of queueing systems, Steady state behaviour of Markovian models (M/G/1, M/M/1, M/M/c) overview of finite capacity and finite calling population models, Network of Queues simulation of single channel queue, multi channel queue, inventory system and dump truck problem using event scheduling approach.	08
3	**Statistical Models in Simulation** Poisson distribution gamma distribution.	06
4	**RANDOM NUMBER GENERATION:** Techniques for generating random numbers- Mid square method -the mod product method -Constant multiplier technique -Additive congruential method -Linear congruential method -Tests for random numbers -The Kolmogorov-Smimov test -the Chi-square test. **RANDOM VARIABLE GENERATION:** Inversion transforms technique-exponential distribution. uniform distribution, Weibull distribution, continuous distribution, generating approximate normal variates-Erlang distribution.	06

5	**Input Modeling**	06
	Introduction, steps to build a useful model of input data, data collection, identifying the distribution with data, parameter estimation, suggested estimators, goodness of fit tests, selection input model without data, covariance and correlation, multivariate and time series input models	
6	**Verification and Validation of Simulation Model**	06
	Introduction, model building, verification of simulation models, calibration and validation of models:- validation process, face validity, validation of model, validating input-output transformation, t-test, power of test, input output validation using historical data and Turing test.	
	Output Analysis	
	Types of simulations with respect to output analysis, stochastic nature of output data, measure of performance and their estimation, output analysis of terminating simulators, output analysis for steady state simulation. variance reduction techniques -antithetic variables, variables-verification and validation of simulation models.	

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:
1. Banks J., Carson J. S., Nelson B. L., and Nicol D. M., "Discrete Event System Simulation", 3rd edition, Pearson Education, 2001.
2. Gordon Geoffrey, "System Simulation", 2nd edition, PHI, 1978.
3. Law A. M., and Kelton, W. D., "Simulation Modeling and Analysis", 3rd edition, McGrawHill, 2000.
4. NarsingDeo, "System Simulation with Digital Computer", PHI.
5. Frank L. Severance, "System Modeling and Simulation"
6. Trivedi K. S., "Probability and Statistics with Reliability, Queueing, and Computer Science Applications", PHI, 1982.
7. Wadsworth G. P., and Bryan, J. G., "Introduction to Probability and Random Variables", McGraw-Hill, 1960.
8. Donald W. Body, "System Analysis and Modeling", Academic Press Harcourt India.
9. Bernard, "Theory OfModeling and Simulation"
10. Levin & Ruben, "Statistics for Management"
11. Aczel and Sounderpandian, "Business Statistics"

Course Code	Course Name	Credits
CCPE1021	**Micro Electro Mechanical Systems**	**03**

Course Prerequisite:

Sensors, Actuators, Instrumentation system and VLSI Technology

Objectives

1. To understand the basic characteristics of MEMS and its processing steps.
2. To demonstrate the use of semiconductor based processing modules used in the fabrication of variety of sensors and actuators (e.g. pressure sensors, accelerometers, etc.) at the micro-scale.
3. To understand the of basic design and operation of MEMS sensors and actuators with proper characterization.
4. To make use of the MEMS devices for real time applications.

Outcomes: Learner will be able to

1. Understand the underlying fundamental principles of MEMS devices including physical operation, mathematical modeling.
2. Select the appropriate material and processes while fabrication of MEMS devices.
3. Design and simulate MEMS devices and system using standard simulation tools.
4. Develop different concepts of micro system sensors and actuators for real-world applications.

Module	Detailed contents	Hours
1	**Introduction to MEMS** Introduction to MEMS & its characteristics, Real world Sensor/Actuator examples (DMD, Air-bag, pressure sensors). MEMS Sensors in Internet of Things (IoT), BioMedical Applications	**4**
2	**MEMS Materials and their Properties** Materials (eg. Si, SiO2, SiN, Cr, Au, Ti, SU8, PMMA, Pt); Important properties: Young modulus, Poisson's ratio, density, piezoresistive coefficients, TCR, Thermal Conductivity, Material Structure. Understanding Selection of materials based on applications	**6**
3	**Fabrication Processes common to MEMS** Understanding MEMS Processes & Process parameters for: Cleaning, Growth & Deposition, Ion Implantation & Diffusion, Annealing, Lithography. Understanding selection of Fab processes based on Applications	**6**
4	**MEMS Specific Fabrication Processes** Understanding MEMS Processes & Process parameters for: Wet & Dry etching, Bulk & Surface Micromachining, Die, Wire & Wafer Bonding, Dicing, Packaging. Understanding selection of Fab processes based on Applications	**8**
5	**MEMS Devices: Architecture and working** basic quantitative behaviour of Cantilevers, Micro-heaters, Accelerometers, Pressure Sensors, Micro-mirrors in DMD, Inkjet printer-head. Understanding steps involved in Fabricating above devices.	**6**

	Piezoresistance, TCR, Stiffness, Adhesion, Vibration, Resonant frequency, & importance of these measurements in studying device behavior, MEMS Reliability	
6	**Applications of MEMS devices** Industrial applications with detailed understanding of role of MEMS as sensors and actuators with proper case studies.	**6**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. An Introduction to Microelectromechanical Systems Engineering; 2nd Ed - by N.Maluf, K Williams; Publisher: Artech House Inc
2. Practical MEMS - by Ville Kaajakari; Publisher: Small Gear Publishing
3. Microsystem Design - by S. Senturia; Publisher: Springer
4. Analysis and Design Principles of MEMS Devices - MinhangBao; Publisher:Elsevier Science
5. Fundamentals of Microfabrication - by M. Madou; Publisher: CRC Press; 2 edition
6. Micro Electro Mechanical System Design - by J. Allen; Publisher: CRC PressMicromachined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill

Course Code	Course Name	Credits
CCPE1022	**Optimization**	**03**

Objectives
1. To understand various linear, nonlinear and other optimization techniques.
2. To understand various decision making methods.

Outcomes: Learner will be able to…

1. Formulate the problem as LPP and analyse the sensitivity of a decision variable.
2. Apply various linear and non linear techniques for problem solving in various domain.
3. Apply decision making methods for problem in manufacturing environment and other domain.

Module	Detailed content	Hours
1	**Basic Concepts:** Statement of the Optimization Problem, Basic Definitions, Optimality Criteria for Unconstrained Optimization Optimality Criteria for Constrained Optimization, Engineering Application of Optimization, Overview of optimization technique, Interdisciplinary nature, Introduction to related software.	6
2	**Linear Programming Problem:** Formulation, Simplex method, Big M Method, Two Phase, Primal to Dual, Dual Simplex method, Sensitivity Analysis.	6
3	**Integer L.P. Model:** Gomory's cutting plane method, Branch & Bound Technique. **Non L.P. Model:** Lagrangian method & Kuhn tucker Method.	6
4	**Multi Criterion Decision-making (MCDM) Methods:** Introduction to multi criterion optimization, Simple Additive Weighting (SAW) Method, Weighted Product Method (WPM), Analytic Network Process (ANP), Analytic Hierarchy Process (AHP) Method, TOPSIS Method, PROMETHEE **Multi Objective Decision making (MODM) Methods:** Introduction to Multi objective optimization, Traditional Techniques such as, quadratic programming, geometric programming, Numerical on goal programming and dynamic programming.	6
5	**Newtonian Method:** Newton's method, Marquardt's method, Quasi Newton method. **Discrete Event Simulation:** Generation of Random Variable, Simulation Processes, Monte-Carlo Technique.	6
6	**Robust Design Methods:** DOE and Taguchi techniques Response Surface Method : Response Surface, The Least-Squares Methods, Two-Level Factorial Design, Addition of Center Points, Central Composite Design(CCD), Sequential Nature of RSM.	6

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**
1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:
1. Ranjan Ganguli, "Engineering Optimization - A Modern Approach" Universities Press
2. Pablo Pedregal, "Introduction to Optimization", Springer
3. S.S. Rao, "Engineering Optimization - Theory and Practice", John Wiley and Sons Inc.
4. L.C. Jhamb, "Quantitative Techniques Vol. 1 and 2", Everest Pub. House
5. Pierre D.A., "Optimization, Theory with Application", John Wiley & sons.
6. Decision Making in the Manufacturing Environment Using Graph Theory and Fuzzy Multiple Attribute Decision Making by R V Rao (Springer Publication).
7. Neural Computation and Self-Organizing Maps by Ritter, H., Martinetz, T., &Schulten, K., Addison-Wesley Publishing Company.

CourseCode	CourseName	Credits
CCPE1023	**AdvancedManufacturingTechnology**	**03**

Objectives

1. Toeducatestudentsaboutnewadvancedmaterials,theirmanufacturingtechniquesandsystems.
2. Tounderstandvariousunconventionalmanufacturingtechniques,coatingtechnologiesforimprovement ofsurface qualities.
3. TointegratemanufacturingelementswithinanorganizationandunderstandE-manufacturingandcollaborativemanufacturing.

Outcomes: Learnerwillbeableto…
1. Understandandapplyvariousadvancedmanufacturingtechniques
2. Analyzeandoptimizesystemrequirementsforadvancedmanufacturingsystems
3. Understandtherelevanceofcloudcomputinginmanufacturingdomainbyintegration ofmanufacturingelementsandusageofwebbasedelements

Module	DetailedContents
01	**IntroductiontoAdvancedManufacturingTechnology** Need,exampleswithatleast2casestudies. Introductiontovariousprocessesofmanufacturingandshapingofmetals,ceramics,plastics,composites
02	**AdvancedManufacturingprocesses**–Introduction,Construction,Workingprinciple, Types, Process of ChemicalMachining,ElectricDischargeMachining,ElectronBeamMachining,PlasmaArcMachining
03	**Surface Treatments** – Scope, Cleaners, Methods types,Ceramicandorganicmethodsofcoating,economicsofcoating,Electroforming,CVDandPVDco Diamondcoatingandcladding.
04	**Advanced Manufacturing Systems**: Components of Manufacturing system, Singlestation ma Algorithm, Mixedmodel Assembly lines, Alternative Assembly systems, Automated production l II IntroductiontoRapidmanufacturingandTooling
05	**IntegrationofManufacturingElements**–ProcessFlowDesignandIntroductiontoSimulatedFactory **E-Manufacturing**–NanoManufacturingtechniquesandmicro-machining,High speedmachiningandhotmachining
06	**CollaborativeManufacturing:**DefinitionandConcept, BusinessProcessChangeConsiderationsforCollaborativeManufacturing Enabling Technolog andLimitationsofCollaborativeManufacturing,CloudManufacturing Methods, DetailcasestudiesonvariousaspectsofCollaborativeManufacturing

Assessment:

Internal:

Assessmentconsistsoftwotestsoutofwhich;oneshouldbecompulsoryclasstest**(onminimumTwo Modules)**andtheotheriseitheraclasstestorassignmentonliveproblemsorcourseproject.

EndSemesterTheoryExamination:

Someguidelinesforsettingupthequestionpaper.Minimum 80%syllabusshouldbecoveredinquestion papers of end semester examination. **In question paper weightage of each module will beproportionaltonumberofrespectivelecturehoursasmentioninthesyllabus.**

1. Questionpaperwillcompriseoftotalsixquestion
2. Allquestioncarryequalmarks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 thenpart(b)willbefromanymodule otherthanmodule 3)
4. OnlyFourquestionsneedtobesolved.

References:

1. SeropeKalpakjianandStevanR.Schmid–ManufacturingProcessEnggMaterials–2003.
2. BrehemT.Smith,AdvancedMachining,I.F.S,UK,1989
3. NarioTaniguchi,NanoTechnology,OxfordUniversityPress,1996
4. HMTManual,Non-TraditionalMachiningMethods
5. Automation,ProductionSystemsandComputerIntegratedManufact uring–Mikell P. Groover,PHI–3rdEdition,2012
6. MaterialScienceandEngineering–WilliamCallister,JohnWileyandSons
7. Engg.MaterialsTechnology,JamesAJacob,ThomasFKilduff–Pearson
8. MechanicalMetallurgy–GeorgeE.Dieter,McGrawHill,1998
9. ProcessandMaterialsofManufacturing–R.A.Lindburg-PHI1990
10. AdvancedMachiningProcesses–V.K.Jain–AlliedPublications
11. IntroductiontoManufacturingProfesses–JohnASchey,McGrawHill
12. ToyotaProductionSystem,TaichiOhno,ProductivityPress,1988,P.58
13. Womack,JamesP,DanielT.Jones,DanielRoos(1990),TheMachinethatchangedt heworld.
14. MuammerKoc,JunNi,JayLee,PulakBandyopadhyay,Introductiontoe-manufacturing,UniversityofMichigan,2005,CRCPress.Pp.97.1–97.9

Course Code	Course Name	Credits
CCIE 1011	**Product Life Cycle Management**	**03**

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development**Outcomes:** Learner will be able to…

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05

06	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of LCA, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
CCIE1012	**Reliability Engineering**	**03**

Objectives:
1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…
1. Apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Assessment:

Internal:

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End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
CCIE 1013	**Management Information System**	**03**

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to…

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide
    value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal:

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End Semester Theory Examination:

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1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
CCIE 1014	**Design of Experiments**	**03**

Objectives:
1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…
1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	**Introduction**	06
	1.1 Strategy of Experimentation	
	1.2 Typical Applications of Experimental Design	
	1.3 Guidelines for Designing Experiments	
	1.4 Response Surface Methodology	
02	**Fitting Regression Models**	08
	2.1 Linear Regression Models	
	2.2 Estimation of the Parameters in Linear Regression Models	
	2.3 Hypothesis Testing in Multiple Regression	
	2.4 Confidence Intervals in Multiple Regression	
	2.5 Prediction of new response observation	
	2.6 Regression model diagnostics	
	2.7 Testing for lack of fit	
03	**Two-Level Factorial Designs and Analysis**	07
	3.1 The 2^2 Design	
	3.2 The 2^3 Design	
	3.3 The General 2^k Design	
	3.4 A Single Replicate of the 2^k Design	
	3.5 The Addition of Center Points to the 2^k Design,	
	3.6 Blocking in the 2^k Factorial Design	
	3.7 Split-Plot Designs	

04	**Two-Level Fractional Factorial Designs and Analysis**	07
	4.1 The One-Half Fraction of the 2^k Design	
	4.2 The One-Quarter Fraction of the 2^k Design	
	4.3 The General 2^{k-p} Fractional Factorial Design	
	4.4 Resolution III Designs	
	4.5 Resolution IV and V Designs	
	4.6 Fractional Factorial Split-Plot Designs	
05	**Conducting Tests**	07
	5.1 Testing Logistics	
	5.2 Statistical aspects of conducting tests	
	5.3 Characteristics of good and bad data sets	
	5.4 Example experiments	
	5.5 Attribute Vs Variable data sets	
06	**Taguchi Approach**	04
	6.1 Crossed Array Designs and Signal-to-Noise Ratios	
	6.2 Analysis Methods	
	6.3 Robust design examples	

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
CCIE 1015	**Operations Research**	**03**

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to…

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.

2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.

3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.

4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05

05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**
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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:
1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
CCIE 1016	**Cyber Security and Laws**	**03**

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to…

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal:

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End Semester Theory Examination:

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4. Only Four question need to be solved.

REFERENCES:

1. Nina Godbole, SunitBelapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi 3.The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings*, Cryptography and Network Security,* Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website   for   more   information   ,   A   Compliance   Primer   for   IT   professional   :   https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Course Code	Course Name	Credits
CCIE 1017	**Disaster Management and Mitigation Measures**	**03**

Objectives:
1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…
1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	**Introduction** **1.1** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	**Natural Disaster and Manmade disasters:** 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **2.2** Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	**Disaster Management, Policy and Administration** 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and coordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	**Institutional Framework for Disaster Management in India:** 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06

05	**Financing Relief Measures:** 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
06	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal:

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End Semester Theory Examination:

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4. Only Four question need to be solved.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by RajdeepDasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
CCIE 1018	**Energy Audit and Management**	**03**

Objectives:
1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…
1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10

05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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4. Only Four question need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Subject Code	Subject Name	Credits
CCL 101	**Program Lab-I** **CAD and Computer Aided Engineering**	**01**

Objectives:
1. Learn concepts of FEA and CFD
2. Learn concepts of 3D-Modeling3.

Outcomes: Learner will be able to…
1. Draft 3D-Modells of Assembly and Individual Components
2. To apply principles of FEA and CFD using appropriate Software.

The laboratory will focus on the following:

Module	Detailed Contents	Lab Sessions
01	3D - Modeling, Assembly & Drafting	5
02	Kinematic & Kinetic Analysis of Mechanisms	4
03	Finite Element Analysis (FEA) or Computational Fluid Dynamics (CFD) or Multibody dynamics (MBD)	4

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
CCSBL101	**Skill Based Lab-I** **Simulation Based Optimization and Data Analytics**	**02**

Objectives:
1. Learn concepts of simulation and Optimization.
2. Learn concepts of Data Analytics
3. Acquire Hands on experience on various simulation tools/optimization tools/Data analytics tools

Outcomes: Learner will be able to…
1. Simulate Manufacturing Process/Manufacturing Systems using suitable software
2. To optimize various process parameters in Manufacturing Processes/Manufacturing System
3.To apply data analytics tools to results obtained through simulation

The laboratory will focus on simulation of **any three** of following

Module	Detailed Contents	Lab Sessions
01	Simulation of Injection Moulding Process and analysis of simulation results using suitable optimization technique or data analytics tools	15
02	Simulation of Casting Process and analysis of simulation results using suitable optimization technique or data analytics tools	15
03	Simulation of Sheet Metal Forming Process and analysis of simulation results using suitable optimization technique or data analytics tools	15
04	Discrete Event Simulation applied in manufacturing system/logistic/Supply Chain or	15
05	Predictive Analytics of systems using Techniques like Monte Carlo Simulation/Markov Chains (Expected to apply these simulation tools to manufacturing related system)	15

Above list is indicative. Any other simulation tool/optimization tool/analytics tools applied to suitable problems can be considered

(Here learner is expected to acquire hands on experience on related simulation tool/optimization tool/Data analytics tool. Learner will document his /her report as case study.
Minimum three case studies are required to be submitted by learner

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners based on report submitted by learner

CourseCode	Course Name	Credits
CCC201	**Industrial Robotics**	**3**

Course Prerequisites:
1. Matrices,
2. Kinematics and Dynamics

Objectives:
1. To get the students acquainted with robotic systems and their applications in flexible or agile manufacturing.
2. To become Familiar with robotic element / peripherals, their selection and interface with manufacturing equipment.
3. To explain the basics of robot kinematics.
4. To explain how machine vision and various image processing methods are applied
5. Students should have knowledge of path control and trajectory planning.

Outcomes: Upon completion of the course, learner should be able to—
1. To apply the robot systems and their applications in agile manufacturing.
2. To Understand application of robotic peripherals, their selection and their utility.
3. To have knowledge of basic robot kinematics.
4. Be acquainted with various image processing techniques.
5. To know path control and different trajectory planning.

Module	Detailed content	Hours
1	**Introduction:** Evolution Automation & robotics, Laws of Robotics, Robotic System & Anatomy Classification, Future Prospects. **Robotic Application in Manufacturing:** Material transfer, Machine loading & unloading, Processing operations, Assembly & Inspectors. **Social Issues and Economics of robotics** **Drives:** Control Loops, Basic Control System Concepts & Models, Control System Analysis, Robot Activation & Feedback Components, Position & Velocity Sensors, Actuators, Power Transmission Systems**.**	4
2	**Robot & its Peripherals:** End Effecters - types, Mechanical & other grippers, Tool as end effecter **Sensors:** Sensors in Robotics, Tactile Sensors, Proximity & Range Sensors, Sensor Based Systems **Robotic Cell Design & Control.**	4
3	**Kinematic Modelling of Manipulator**: Mechanical Structure and Notations, Coordinate Frames, DenavitHartenberg Notation, Arm Equation of Planer Robot, Four axis SCARA Robot, TCV, Inverse Kinematics of Planer Robot, Four Axis SCARA Robot. Inverse Kinematic	8

4	**Trajectory Planning & Robot Dynamics:** Manipulator Path Control- Linear, Quadratic and Cubic Interpolation, Work Space Analysis, Robot Dynamics –Lagrangian Dynamics of one and two link robot arm.	8
5	**Machine Vision:** Introduction, Low level & High level vision, Sensing & Digitizing, Image processing & analysis, Segmentation, Edge detection, Object description & recognition, Interpretation, Noises in Image, Shape Recognition , Applications,	7
6	**Programming For Robots:** Methods, Robot programme as a path in space, Motion interpolation, level & task level languages, Robot languages; Programming in suitable languages Characteristics of robot **Robot Intelligence & Task Planning:** Introduction, State space search, Problem reduction, Use of predictive logic, Means -Ends Analysis, Problem solving, Robot learning, Robot task planning.	5

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Robotics and Control by R. K. Mittal and I J Nagrath, Tata Mcgraw Hill
2. Industrial Robotics by Groover and Simmers
3. Handbook of Industrial Robotics, Shimon Y. Nof. Wiley Publications, ISBN: 978-0-471-17783-8
4. Robotics , Vision and Control by Peter Corke, Springer
5. Robotics: Control Sensing. Vis. K S Fu,RalphGonzalez,C S G Lee

Course Code	Course Name	Credits
CCC202	**Computer Aided Machining (CAM)**	**03**

Course Prerequisites:
   Basics machining operation.

Objectives
1. To familiarize with CNC hardware.
2. To familiarize with operation and programming of CNC machines.
3. To familiarize with concepts of computer aided machining and its significance.

Outcomes: Learner will be able to…
1. Write and run CNC program for Turning and Milling.
2. Write program for CNC EDM and wire EDM
3. Do simple hardware designs
4. Do interfacing of drive systems with the machines

Module	Detailed Contents	Hrs.
01	**Introduction to Computer Numerical Control**. History of various NC machines like TNC, NC, CNC, DNC, Elements of CAM, Various CNC applications in different industries, Computer control concepts, Data processing units, Binary execution	4
02	**CNC Hardware** Structure of CNC machine tools, Spindle design, Spindle and axis drives, Various actuation systems and feedback devices like encoder, tachogenerator, etc.	6
03	**CNC Control System and Machine Tools.** CNC motion controller, Linear, circular, helical interpolator, Positioning and contouring control loops, MCU, adaptive control system, CNC machining centre, turning, grinding, EDM, wire EDM, boring, turn mill and CNC gear cutting, Study of two control systems.	6
04	**CNC Tooling.** Latest CNC tool materials and manufacturing, Turning and milling tool geometry, Tool probing and presetting, Automatic Pallet Changer (APC) and Automatic Turret Changer (ATC), Study of various probes and special tools.	6
05	**CNC Programming.** Part programming fundamentals, Manual part programming methods, Various G & M codes, Absolute and incremental system, TNRC, Tool length and diameter compensation, Programming of turning, machining centre and EDM, Use of canned cycles, loop, jump, subroutines	8
06	R Parameter programming, Macros	6

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. P. Radhakrishnan& S. Subramanyan "CAD/CAM/CIM" Willey Eastern Limited New Delhi.
2. Hans B. Kief and J. Frederick Waters "CNC" Glencae Macmillan / McGraw Hill
3. Steve Krar and Arthar Gill "CNC Technology and Programming", McGraw Hill Pub. Company, New Delhi.
4. P.N. Rao, N. K. Tewariet el "CAM" Tata McGraw Hill Pub. New Delhi

Course Code	Course Name	Credits
CCPE2011	**Product Design**	**03**

Objectives:
1. To understand various approaches to product design and development.
2. To comprehend the numerous DFX principles that are employed in product design.
3. To become acquainted with modern methodologies such as FMEA, value engineering, concurrent engineering, product life cycle management, robust design, rapid prototyping etc.
4. To comprehend the economics of product development and design.

Outcomes: Upon completion of the course, learner should be able to—

1. Design and develop products right from the conceptual level.
2. Illustrate various modern approaches like concurrent engineering, product life cycle management, robust design, rapid prototyping / rapid tooling.
3. Analyse products based on ergonomics and aesthetic aspects.
4. Evaluate the economic aspects in product development.

Module	Detailed content	Hours
1	**Introduction:** Importance of product design, types of design, product definition, product specifications, product mix, Morphology of design, phases in product design and development, Market research, Benchmarking, Concept generation and evaluation methods, product architecture, Supplier involvement in product design, customer centric product design, Creativity and Idea generation techniques, importance of Quality Dimensions: Performance, Features, aesthetics, ergonomics, Reliability, Sustainability, Serviceability, Brand value, Value Vs cost	8
2	**Material selection:** Importance, classification material performance characteristic, selection criteria Ashby Material selection chart. New developments in materials: Special alloys, Composites and Ceramics. **Process selection:** Importance types of manufacturing process and their classification, Sources of information selection criteria Material and Process selection Methods, Expert systems. Computer Database Approach, performance indices decision matrix, AHP and fuzzy approach introduction to material and process selection software. Axiomatic design principles and case studies.	6
3	**Design Principles:** Design for Manufacturing (DFM) and Design for Assembly (DFA), Designs for Maintainability, Designs for environment and other DFX principles. **Robust Design:** Taguchi Designs, Design of Experiments (DOE) **Designing with plastics:** Mechanical behavior, special characteristics and considerations, Design concepts for plastic product features to be manufactured by various production process technologies;	6

4	**Product Ergonomics:** Anthropometry, Environmental conditions, thermal, noise, vibration, displays, illusions, Psycho and psychological aspects in design, Man-machine information exchange. **Product Aesthetics**: Visual awareness, Form elements in context of product design, Concepts of size, shape and texture, Introduction to colour and colour as an element in design, Colour classifications and dimensions of colour, Colour combinations and colour dynamics, Interaction / communication of colours, Psychological aspects of colours, generation of products forms with analogies from nature.	4
5	**Value Engineering:** Product value and its importance, definition, Value analysis job plan, FAST, case studies. **Modern Applications:** Robust design, QFD, Design & process FMEA, Reverse Engineering, Concurrent engineering & Sequential engineering, Rapid Prototyping/Additive Manufacturing, Product life cycle Management techniques	8
6	**Economics of Product Development:** Methods of cost Estimates, Cost Comparison, Depreciation, Taxes. Principals of Economy, Engineering Economy and Design Process, Economic Analysis, Inflation, Time Value of Money, Numerical on Net Present Value (NPV) method. Industrial Engineering Approach, parametric Approach, profitability of investment and Investment Decision Analysis, Legal and social issues, Patents and IP acts.	4

Assessment:

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End Semester Theory Examination:

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1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Product Design and Development by Ulirich Karl T. and Eppinger Steven D, McGraw Hill.
2. Product Design and Manufacturing by A.K.Chitale, R.C.Gupta, PHI.
3. Engineering Design by Dieter George E., McGraw Hill.
4. Design Fundamentals, R. G. Scott.
5. Handboook of Product Design for Manufacturing by Bralla, James G, McGraw Hill.
6. Product Design by Kevin Otto & Kristin

Course Code	Course Name	Credits
CCPE2012	**Advanced Finite Element Analysis**	**03**

Course Prerequisites:
1. Basic calculus
2. Differential Equations

Objectives:
1. To develop proficiency in finite element method after understanding the fundamental principles of FEM to solve realistic engineering problems in the field of thermal engineering, structural engineering, vibration analysis, fluid flow, etc.

Outcomes: Learner will be able to…
1. Generate the governing Finite element equations for systems governed by partial differential equations
2. Solve problems related trusses, heat transfer, free vibrations and fluid flow problems
3. Solve time dependent and / or non-linear problems
4. Use commercial software package to perform structural analysis, heat transfer modeling, fluid flow modeling and interpret the results.

Module	Detailed content	Hrs.
1	**Introduction to FEA, General FEM procedure,** • Approximate solutions of differential equations: FDM method, W-R technique, collocation least square sub-domain and Galerkin method • Numerical integration, Gauss quadrature in 2-D and 3-D • Structure of FEA program, Pre and Post processor, commercially available standard packages, and desirable features of FEA packages. • Principal of minimum total potential, elements of variational calculus, minimization of functional, Rayleigh-Ritz method, Formulation of elemental matrix equation, and assembly concepts.	8
2	**One Dimensional FEM:** • Coordinate system: Global, local, natural coordinate system. • Shape functions: Polynomial shape functions, Derivation of shape functions, Natural co-ordinate and coordinate transformation, Linear quadratic and Shape functions using Lagrange polynomials • One dimensional field problems: structural analysis (step-bar, taper-bar). Structural analysis with temperature effect, Thermal analysis, heat transfer from composite bar, fins.	6
3	• Trusses, Thermal effects in truss members, Beams. • Two dimensional finite elements formulations, Three-noded triangular element, Four-noded rectangular element, Four-noded quadrilateral element, derivation of shape functions: natural coordinates, triangular elements, and quadrilateral elements. • Six-noded triangular elements, Eight-noded quadrilateral elements, Nine-noded quadrilateral element; Strain displacement matrix for CST element	6
4	• Penalty Method, Lagrange methods, Multipoint Constraints • Concept of Master/Slave entities • Examples of Contact problems. • Iso-parametric concepts, basic theorem, Iso-parametric, super-parametric, sub-parametric elements, Concept of Jacobian	

5	• Finite element formulation of Dynamics, application to free-vibration problems, Lump and consistent mass matrices, Eigen value problems. • Transient dynamic problems in heat transfer • Introduction to time-integration methods: Implicit and Explicit methods • Convergence, Impact of Mesh quality on convergence	5
6	• Three dimensional elements: Tetrahedron, Rectangular prism (brick), Arbitrary hexahedron; Three Dimensional polynomial shape functions, Natural co- ordinates in 3D, • Introduction to material models: Introduction to plasticity (Von-Mises ○ Plasticity, Hyper –elasticity. • Errors in FEA, sources of errors, method of elimination, Patch test.	5

Assessment:

Internal:

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End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. O. C. Zienkiewicz, R. L. Taylor & J. Z. Zhu, "The Finite Element Method its Basis and Fundamentals", Butterworth-Heinemann, Elsevier
2. Reddy J. N., "Finite Element Method", McGraw-Hill
3. S. S. Rao, "The Finite Element Method in Engineering" , 4th Edition, Academic Press, Elsevier
4. U. S. Dixit, "Finite Element Methods for Engineers", Cengage Learning
5. P. Seshu, "Textbook of FE Analysis", Prentice Hall
6. Desai and Abel, "Introduction to Finite Elements Methods", CBS Publication
7. Tirupati R. Chandrupatla and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering"
8. Erik Thompson, "Introduction to Finite Element Methods", Wiley India
9. H. Kardestuneer, "Finite Elements Hand Book"
10. R. D. Cook, "Concepts & Applications of Finite Element Analysis"
11. Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall of India
12. Huebener K.H., Dewhirst D.D., Smith D.E. and Byrom T.G., "The Finite Element Method for Engineers", John Wiley, New York
13. Logan, "Finite Element Methods" Cengage Learning
14. George Buchanan, "Finite Elements Analysis", McGraw Hill
15. C. S. Krishnamoorthy, "Finite Elements Analysis", Tata McGraw-Hill
16. Robert Cook, "Concept and Application of Finite Element Methods", Wiley India.

Course Code	Course Name	Credits
CCPE2013	**Control Engineering**	**03**

Course Prerequisites:
    Laplace Transform

Objectives:
1. To impart an advanced understanding of classical controls theory
2. To understand the equivalent mechanical and electrical systems

Outcomes: Upon completion of the course, learner should be able to—
1. Model system and find Transfer function.
2. Check stability of a mechanical system.
3. Understand response of second order system
4. Understand controllability and observability of linear system

Module	Detailed content	Hours
1	**Introduction to control systems.** Classification of control system, Effect of feedback. Mathematical modeling of control systems (mechanical, electrical systems), concept of transfer function. Block diagram algebra, and signal flow graphs.	6
2	**Time response analysis:** Time response of control system, standard test signal, Time Response Analysis of First and Second order system, Time Domain specifications. Step response of second order system. Steady-state errors, static error constants, steady state, analysis of different type of systems using step. Ramp and parabolic inputs. Response with P,PI,PD,PID Controller.	8
3	**Classification of control systems according to 'TYPE' of systems, Stability analysis:** Introduction to concepts of stability. The Routh and Hurwitz stability criteria. Relative stability analysis.	6
4	**Root locus Techniques.** Frequency Response Analysis, Frequency domain specifications Correlation between time and frequency response. Polar Plots. Bode Plots, Nyquist Plots,	6
5	**State space modeling:** Concept of state, state variable, state model. State space representation using physical and phase variables, decomposition of transfer function, diagonalisation. State transition matrix. Transfer function from state model. Controllability and observably of linear system.	6

6	**Compensation (Introduction only):** Types of compensator, selection of compensator, Lead, Lag and Lag-Lead compensation. Control system Components : servomotor, stepper motors, Synchros, Potentiometer, amplifiers	4

Assessment:

Internal:
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End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Control System Engineering: by Nagrath LT. and Gopal .M., Wiley Eastern Lid.
2. Modem Control engineering: by K.Ogata, Prentice Hall.
3. Benjamin C. Kuo, Automatic Control Systems, Pearson education, seventh edition.
4. MadanGopal, Control Systems Principles and Design, Tata McGraw Hill, seventh edition, 1997
5. Nise, control system Engineering, John wiley& sons, 3rd edition

Course Code	Course Name	Credits
CCPE2021	**Rapid Manufacturing**	**03**

Course Prerequisites:
1. CAD Modelling

Objectives:
1. To become familiar with different rapid manufacturing techniques.
2. To familiarize with a variety of software tools for product design and development using rapid manufacturing processes.
3. To familiarize with how these techniques are used in various technical and biomedical disciplines.

Outcomes: Learner will be able to...
1. Demonstrate knowledge of different rapid manufacturing techniques.
2. Gain experience in product design and development using rapid manufacturing technology.

Module	Detailed Contents	Hrs
01	**Rapid Manufacturing** • Historical Development • Additive, Subtractive and Formative Manufacturing • Applications: Design, Planning, Manufacturing and Tooling • Applications: Automotive, Aerospace, Electronics, Jewelry, BioMedical • Fundamentals of Rapid Prototyping and Manufacturing, Design Process • Rapid Prototyping and Manufacturing Process Chain • Classification of Additive Manufacturing Processes	5
02	**Rapid Manufacturing System and Methodology** • Subsystems of RP machine • Optical System • Mechanical Scanning System • Computer Interfacing hardware, DAQs • Signal Flow, 3D Model to RP Prototype • Introduction to 3D ModelingSoftwares (Auto-CAD, PROE, CATIA, SOLIDWORKS, IDEAs etc.) • File Formats: IGES, STEP, DXF, STL • Slicing and Scan Path Generation Algorithms • Data Conversion and Transmission • Data Validity and Repair • Preprocessing and Post-processing • Properties of the prototype/part: Material properties, color, dimensional accuracy, stability, surface finish, machinability, environmental resistance, operational properties	7

03	**Liquid Based Rapid Prototyping Systems**
	  • Materials
	  • Stereolithography
	  • Solid Ground Curing
	  • Solid Object UV (Ultra-Violet) Printer
	  • Micro-stereolithography
		6

04	**Solid Based Rapid Prototyping Systems**
	  • Materials
	  • LOM (Laminated Object Manufacturing) System
	  • FDM (Fused Deposition Modeling) System
	  • Multi-Jet Modeling (MJM) System
	  • Model Maker and Pattern Master
	  • Shape Deposition Manufacturing Process
		6

05	**Powder Based Rapid Prototyping Systems**
	  • Materials
	  • SLS (Selective Laser Sintering)
	  • (3DP) Three-Dimensional Printing
	  • (LENS) Laser Engineered Net Shaping
	  • (MJS) Multiphase Jet Solidification
	  • (EBM) Electron Beam Melting
		6

06	**Advances in Rapid Manufacturing and Case Studies** Advances in Rapid Manufacturing: Resolution & Accuracy issues, Integrated Hardening Process, Reverse Engineering Process and Applications, Metal Additive Manufacturing, Two Photon Process for Micro/Nano Fabrication, Printing with Biocompatible Materials, Case Study: Investment Casting with RP Case Study: Wind-Tunnel Testing with RP Models, Case Study: Manufacture of Human implants and prosthesis	6

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**
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   2. All question carry equal marks
   3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
   4. Only Four questions need to be solved.

References:

- Chua C.K., Leong K.F., and Lim C.S., "Rapid Prototyping Principles and Applications", World Publishing Co. Pte. Ltd.
- Gibson, D.W. Rosen, and B. Stucker, "Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing", 2010, Springer Inc.
- Ali Kamrani, Emad Abouel Nasr, "Rapid Prototyping Theory and Practice", 2006, Springer Inc.
- BopayaBidanda, Paulo J. Bartolo, "Virtual Prototyping and Bio Manufacturing in Medical Applications", 2008, Springer Inc.
- Rafiq Noorani, Rapid Prototyping: Principles and Applications, John Wiley & Sons, Inc., 2006, ISBN 0-471-73001-7
- James O. Hamblen, and Michael D. Furman, "Rapid Prototyping of Digital Systems", Kluwer Academic Publishers.
- Kenneth G. Cooper, "Rapid Prototyping Technology Selection and Application", 2001, Marcel Dekker Inc, New York.

Course Code	Course Name	Credits
CCPE2022	**Sustainable Manufacturing**	**03**

Objectives
1. To study sustainable principles in Manufacturing operations
2. To improve sustainability in present manufacturing systems.
3. To study innovation and research in sustainable manufacturing

Outcomes: Learner will be able to…
1. Understand basic principles of sustainable developments for social, economical and technological growth of nation and to be aware of SDGs.
2. To identify, evaluate, and improve the sustainability of manufacturing
3. To research, innovate and design sustainable manufacturing, services for future needs.

Module	Detailed Contents	Hrs.
01	**Introduction:** A brief history of Manufacturing, Commerce and Sustainability. 3 pillars of Sustainability, What is Sustainable Development and its goals – SDGs, Relationship between workplace organization, inventory levels and sustainability, Green Expectations and Green Movement.	**06**
02	**Waste Management:** Types and categories of Industrial Wastes? Processing Techniques of Waste. Description of types of Manufacturing Wastes. Bio-Processing methods. Implication of 3R principles of Waste Management in Industry, Government Regulations and Subsidies provided for Waste Management (Case studies)	**06**
03	**Potential health and environmental effects** of International trade and manufacturing operations, Principles of pollution prevention, industrial ecology, environmental and life-cycle assessments , Recommendations for risk management in manufacturing.	**06**
04	**Environment friendly materials** : Materials for sustainability, alternative manufacturing practices , materials and selection of manufacturing processes , control on use of renewable materials , Bio-degradable materials, recycling of materials. Introduction to Environmental and economic effects of a good new product development process	**06**
05	**Energy Management:** renewable energy, Innovations in generation, conservation, recycling and usage of energy. Energy audit and implications. **Sustainability Awareness:** sustainability rating schemes, eco-labelling programmes, human values and professional ethics in sustainable manufacturing. Encouraging innovations in sustainable manufacturing (Case studies)	**06**

06	**Continuous Improvement and Sustainability** : Importance and some recommendations on how to implement a continuous improvement project , Recommendations to enhance employee involvement in any continuous improvement project, Some recommended practices when implementing a continuous improvement project , Relationship between continuous improvement and sustainability	06

Assessment:

Internal:
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End Semester Theory Examination:
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1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:
1. Strategic Management of Sustainable manufacturing operations (Advances in logistics operations & Management) By. Rameshwar Dubey &AngappaGunabekaran by Imuste Productivity press.
2. Analysis for Smart energy management: Tools and applications for sustainable manufacturing. By Seog-chanoh and Alfred. J. Hildreth , Springer Series.
3. Advances in sustainable Manufacturing By Gunther Seliger and Marwan M.K. khraishah, Springer Series
4. Green Management by M.Karpagam, Geetha Jaikumar, Ane Books Pvt.Ltd.
5. Design for Environment: A guide to sustainable Product Development.
6. Sustainable Development By M.K. Ghosh Roy Ane Books Pvt.Ltd
7. Palevich, Robert. "The Lean Sustainable Supply Chain: How to Create a Green Infrastructure with Lean Technologies". FT Press, 2012

Course Code	Course Name	Credits
CCPE2023	**Internet of Things**	**03**

Course Prerequisites:
  1. Mechatronics basics, Microprocessor

Objectives:
  1. To provide the students with the basic knowledge and technical understanding in the field of Internet of Things (IoT)
  2. To Study core IoT Functional Stack
  3. To understand the various application protocols commonly used for IoT
  4. To study the Hardware and Software platforms used for implementing IoT in Projects

Outcomes: Upon completion of the course, learner should be able to—
  1. Understand IoT and Various associative Technologies
  2. Implement Core IoT Functional Stack and Understand Application Protocols
  3. Apply IoT technologies to key Industries
  4. Examine various Hardware and software platforms used in IoT

Module	Detailed content	Hours
1	Introduction and application to Internet of Things: Need of IoT, history of IOT, Impact of IOT – Roadways, factory building and Smart creatures, , IoT Challenges, Objects of IOT , the Iot World Forum Standard Architecture Level of IOT, Technologies in IOT,	6
2	Sensors/Transducers – Definition, Principles, Classifications, Types, Characteristics and Specifications, Actuators -– Definition, Principles, Classifications, Types, Characteristics and Specifications Smart Object – Definition, Characteristics and Trends,	6
3	Sensor Networks – Architecture of Wireless Sensor Network, Network Topologies, Wireless Technologies Supporting IoT: Protocol Standardization for IoT, Machine to machine (M2M) and WSN protocols, Basics of RFID , RFID Protocols, Issues with IOT Standardization, Protocols – IEEE 802.15.4, Zigbee, IPv6 Technologies for IOT	8
4	Data Analytics for IOT: Introduction Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real Tie Data Analysis, Structural Health Monitoring, Case Study :Chef Case Study, puppet Case Study	6
5	Introduction to Cloud Computing, Difference between Cloud Computing and FOG Computing: The Next Evolution of Cloud Computing, Role of Cloud Computing in IOT, Connecting Iot to Cloud, Cloud Storage for IoT Challenge in Integration of IoT with Cloud	6

6	Domain Specific IoT : Home Automation – Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities – Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Environment – Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, Energy – Smart Grids, Renewable Energy Systems, Prognostics, Retail – Inventory Management, Smart Payments, Smart Vending Machines, Logistics – Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring, Agriculture – Smart Irrigation, Green House Control, Industry – Machine Diagnostics & Prognosis, Indoor Air Quality Monitoring, Health & Lifestyle – Health & Fitness Monitoring, Wearable Electronics	4

Assessment:

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Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 st Edition, Published by Pearson Education, Inc, publishing as Cisco Press, 2017.
2. HakimaChaouchi, "The Internet of Things - Connecting Objects to the Web", 1 st Edition, Wiley, 2010.
3. Perry Lea, "Internet of things For Architects", 1 st Edition, Packt Publication, 2018
4. ArshdeepBahga, Vijay Madisetti, "Internet of Things – Hands-On Approach", 2 nd Edition, Universities Press, 2016.
5. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", 1 st Edition, Wiley, 2014.
6. Donald Norris, "Raspberry Pi – Projects for the Evil Genius", 2 nd Edition, McGraw Hill, 2014.
7. Anand Tamboli ,"Build Your Own IoT Platform", 1 st Edition, Apress, 2019.

Course Code	Course Name	Credits
CCIE2011	**Project Management**	**03**

Objectives:
1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…
1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	8

06	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects.Multicultural and virtual projects. **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.

2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA

3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Code	Course Name	Credits
CCIE 2012	**Finance Management**	**03**

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10

05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

    1.   Question paper will comprise of total six question

    2.   All question carry equal marks

    3.   Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

    4.   Only Four questions need to be solved.

References:

    1.   Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.

    2.   Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.

    3.   Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

    4.   Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
CCIE 2013	**Entrepreneurship Development and Management**	**03**

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. PoornimaCharantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. MaddhurimaLall, ShikahSahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. LaghuUdyogSamachar 11.www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Credits
CCIE 2014	**Human Resource Management**	**03**

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	**Organizational Behavior (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decisionmaking, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6

04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - JobSatisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning.	5
	☐ Training & Development: Identification of Training Needs, Training Methods	
05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

    1.   Question paper will comprise of total six question
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    4.   Only Four questions need to be solved.

References:

    1.   Stephen Robbins, Organizational Behavior, 16th Ed, 2013
    2.   V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
    3.   Aswathapa, Human resource management: Text & cases, 6th edition, 2011
    4.   C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
    5.   P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
    6.   Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
CCIE 2015	**Professional Ethics and Corporate Social Responsibility (CSR)**	**03**

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Assessment:

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End Semester Theory Examination:

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      4.   Only Four questions need to be solved.

References:

      1.   Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.

      2.   Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.

      3.   Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.

      4.   Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

Course Code	Course Name	Credits
CCIE 2016	**Research Methodology**	**03**

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter   areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	09
02	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	07
03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f.** Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	08
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	04

Assessment:

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End Semester Theory Examination:

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     4.   Only Four questions need to be solved.

References:

     1.   Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.

     2.   Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.

     3.   Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2[nd]ed), Singapore, Pearson Education

Course Code	Course Name	Credits
CCIE 2017	**IPR and Patenting**	**03**

Objectives:
1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Assessment:

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End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. PrabhuddhaGanguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, PritiMathur, AnshulRathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Course Code	Course Name	Credits
CCIE 2018	**Digital Business Management**	**03**

Objectives:
1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..
1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04

| 6 | **Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations** | 08 |

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. A textbook on E-commerce**,** ErArunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Course Code	Course Name	Credits
CCIE 2019	**Environmental Management**	**03**

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	**Introduction and Definition of Environment:** Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	**Global Environmental concerns:** Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Manmade disasters, Atomic/Biomedical hazards, etc.	06
03	**Concepts of Ecology:** Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	**Scope of Environment Management**, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	**Total Quality Environmental Management**, ISO-14000, EMS certification.	05
06	**General overview of major legislations** like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,**T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Subject Code	Subject Name	Credits
CCL201	**Program Lab-I** **CAM and Additive Manufacturing**	**01**

Objectives:
1. Learn concepts of Rapid Manufacturing
2. Learn concepts of CNC Programming.

Outcomes: Learner will be able to…
1. Write and run CNC program for Turning and Milling.
2. Gain experience in product design and development using rapid manufacturing technology.

The laboratory will focus on the following:

Module	Detailed Content	Lab Sessions
1	3D Modeling and creating STL files	2
2	3D Printing of components	3
3	Operation, programming of CNC turning and milling	4
4	Tool path Simulation using software.	4

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
CCSBL201	**Skill Based Lab-I** **Mechatronics and Robotics**	**02**

Objectives:
1. Learn concepts of Pneumatic and Hydraulic Systems
2. Learn concepts of Direct and Inverse Kinematics.

Outcomes: Learner will be able to…
1. Design Pneumatic and Hydraulic Circuits for Industrial Applications
2. Design the Direct or inverse kinematics for a given Industrial Robotic Arm

The laboratory will focus on the following:

Module	Detailed Contents	Lab Sessions
01	Design and excecute Pneumatic and Hydraulic Circuit	4
02	Direct and Inverse Kinematic Simulation	3
03	Experiment on Robot Vision	2

*Note : Each lab session is equal to 4 hours

 Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
CCMP301	**Major Project:** **Dissertation - I**	**10**

Guidelines for Dissertation-I

Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format. Guidelines for Assessment of Dissertation-I.

Dissertation-I should be assessed based on following points
- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization
- Clarity of objective and scope Dissertation-I should be assessed through a presentation by a panel of Internal examiners and external examiner appointed by the Head of the Department/Institute of respective Programme.

Subject Code	Subject Name	Credits
CCMP401	**Major Project:** **Dissertation - II**	**16**

Guidelines for Assessment of Dissertation II

Dissertation II should be assessed based on following points:
- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization or current Research / Industrial trends
- Clarity of objective and scope
- Quality of work attempted or learner contribution
- Validation of results
- Quality of Written and Oral Presentation

Students should publish at least one paper based on the work in referred National/ International conference/Journal of repute.

*Dissertation II should be assessed by internal and External Examiners appointed by the University of Mumbai.