



RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

R.V. Vidyaniketan Post, Mysore Road

Bengaluru – 560 059



Scheme and Syllabus of I & II Semesters (Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)

in

PRODUCT DESIGN AND MANUFACTURING

**DEPARTMENT OF
MECHANICAL ENGINEERING**

**College Vision & Mission
(To be included from our side)**

DEPARTMENT VISION

Quality Education in Design, Materials, Thermal and Manufacturing with emphasis on Research, Sustainable technologies and Entrepreneurship for Societal Symbiosis

DEPARTMENT MISSION

1. Imparting knowledge in basic and applied areas of Mechanical Engineering
2. Providing state-of-art laboratories and infrastructure for academics and research
3. Facilitating faculty development through continuous improvement programs
4. Promoting research, education and training in frontier areas of nanotechnology, advanced composites, surface technologies, MEMS and sustainable technology
5. Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy
6. Imbibing social and ethical values in students, staff and faculty through personality development programs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Practicing design of engineering systems through the application of the fundamental knowledge and skills of Mechanical Engineering

PEO2 Enhancing analytical, numerical, experimental, research and project management skills through training, independent inquiry, and professional development.

PEO3 Working independently as well as collaboratively, while demonstrating the professional and ethical responsibilities of the engineering profession.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO	Description
PSO1	Demonstrate basic knowledge in Mathematics, basic science, Materials Science and Engineering to formulate and solve mechanical engineering problems
PSO2	Design mechanical and thermal systems by adopting numerical, analytical and experimental techniques and analyse the results.
PSO3	Function in multidisciplinary teams with sound communication skills.
PSO4	Self-learn to acquire and apply allied knowledge and update the same by engaging in life-long learning, practice profession with ethics and promote entrepreneurship .

Lead Society: American Society of Mechanical Engineers – ASME

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	CE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PHY	Physics
21.	CHY	Chemistry
22.	MAT	Mathematics

INDEX

III Semester			
Sl. No.	Course Code	Course Title	Page No.
1.	18 MPD 31	Advanced Materials & Processes	
2.	18 XXX3EX	Elective 5	
3.	18 MPD 32	Internship	
4.	18 MPD 33	Dissertation Phase I	
5.	18 MPD 31	Advanced Materials & Processes	
GROUP A: CORE ELECTIVES			
1.	18 MPD 3E1	Sheet Metal Forming and Plastic Moulding	
2.	18 MPD 3E2	Surface Engineering	
3.	18 MCM 3E3	Advanced Manufacturing Practices	

R V COLLEGE OF ENGINEERING, BENGALURU-560 059
(Autonomous Institution Affiliated to VTU, Belagavi)
DEPARTMENT OF MECHANICAL ENGINEERING
M.Tech in PRODUCT DESIGN AND MANUFACTURING

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	Course Code	Course Title	BoS	Credit Allocation			
				L	T	P	Total Credits
1	18 MPD 31	Advanced Materials & Processes	ME	4	1	0	5
2	18 XXX3EX	Elective 5	ME	4	0	0	4
3	18 MPD 32	Internship	ME	0	0	5	5
4	18 MPD 33	Dissertation Phase I	ME	0	0	5	5
Total number of Credits				8	1	10	19
Total Number of Hours / Week				16	2	20	48

LIST OF ELECTIVE COURSES

Group E : Core Electives	
18 MPD 3E1	Sheet Metal Forming and Plastic Moulding
18 MPD 3E2	Surface Engineering
18 MCM 3E3	Advanced Manufacturing Practices

M.TECH FOURTH SEMESTER							
Sl. No	Course Code	Course Title	BoS	CREDIT ALLOCATION			Credits
				L	T	P	
1	18MPD41	Dissertation Phase II	ME	0	0	20	20
2	18MPD42	Technical Seminar	ME	0	0	2	2
				0	0	22	22

Semester: III						
ADVANCED MATERIALS & PROCESSES						
Course Code	:	18MPD31		CIE Marks	:	100
Credits L: T: P	:	4:1:0		SEE Marks	:	100
Hours	:	48L		SEE Duration	:	3 hrs

Unit – I	
<p>Structure-Property Relations & Newer Materials: Introduction, Atomic structure, atomic bonds, secondary bonds, crystal structure, Crystal structure, crystal defects, grain structure, elastic and plastic deformation in single crystals, strain /work hardening, plastic deformation in polycrystalline metals, fracture of metals.</p> <p>Newer Materials: Plastics, polymerization thermosetting and thermoplastic materials and properties. Ceramic materials and their properties. Composite materials – classification, matrix and reinforcement materials, properties, rule of mixtures, longitudinal strength and modulus (isostrain model), transverse strength and modulus (isostress model), applications of composites.</p>	10 Hrs
Unit – II	
<p>Processing of Composites: Processing of MMCs : matrix and reinforcement materials, diffusion bonding, squeeze casting, reocasting, arc spray forming, superplastic forming, in situ process. Processing of CMCs : matrix and reinforcement materials, fabrication of glass fibers, boron fibers, carbon fibers, alumina fibers, silicon carbide fibers. Processing- slurry infiltration process, melt infiltration process, direct oxidation or Lanxide process.</p> <p>Processing of PMCs: matrix and reinforcement materials, processing of polyethylene fibers, aramid fibers. Processing of PMCs – hand layup process, spray-up technique, filament winding process, pultrusion process, autoclave moulding.</p>	12 Hrs
Unit – III	
<p>Powder Metallurgy: Introduction, Production of Powder, Characterization & Testing of Powders, Powder Conditioning, Powder Compaction, Sintering, Finishing operations, Applications of PM components.</p> <p>Surface Treatment: Introduction, Surface Engineering, Surface quality & integrity concepts, Mechanical treatment, Thermal spraying processes and applications, Vapour depositions processes and applications, Ion-implantation.</p>	12 Hrs
Unit – IV	
<p>Environmental Degradation of Materials: Different forms of environmental degradation, cost of corrosion, electrochemical nature, forms of corrosion- Galavanic, Intergranular, pitting, stress related corrosion. Corrosion control- Materials selection, protective coating.</p> <p>Smart materials : Smart materials and their properties, Piezoelectric, magneto</p>	08 Hrs

structure, shape memory materials, Electro Rheological fluids, optical fibres.	
Unit – V	
Thin film: Sol-gel, spin coating, sputtering deposition, ion implementation, cathodic arc deposition, pulsed laser deposition	10 Hrs
Characterization –Scanning probe microscopy, Atomic force microscopy, Scanning tunneling microscopy, Profilometer, applications of thin films in different areas.	

Course Outcomes: After going through this course the student will be able to:	
CO1	Explain the concepts and principles of advanced materials and manufacturing processes
CO2	Analyze the materials and processes for particular application
CO3	Understand the concept of powder metallurgy technique
CO4	Evaluate the principles and application of surface treatment methods

Reference Books:	
1	E. Paul Degarmo, J.T. Black, and Ronald A Kohser. “Materials and Processing in Manufacturing,” John Wiley and Sons Inc., 12 th Edition, 5 th July 2017, ISBN: 978-1118987674.
2	K.K.Chawla, “Composite Materials: Science & Engineering,” Springer-Verlag, New York, 3 rd Edition, 2012, ISBN: 978-0387743646.
3	V. S. R Murthy, A. K. Jena, K. P. Gupta and G.S.Murthy, “Structure and Properties of Engineering Materials,” Tata McGraw Hill Education, 2003, ISBN: 9780070482876.
4	Rakesh Rathi, “Nanotechnology,” S.Chand and Company, 1 st December 2010, ISBN: 978- 8121930826.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Semester: III						
SHEET METAL FORMING AND PLASTIC MOULDING						
Course Code	:	18 MPD3E1		CIE Marks	:	100
Credits L: T: P	:	4:0:0		SEE Marks	:	100
Hours	:	48L		SEE Duration	:	3 hrs

Unit – I	
<p>Sheet Metal Operations: Classification of presses, sheet metal operations, shearing theory, cutting force, clearance between punch and die, shut height and daylight, press tonnage calculation.</p> <p>Strip Layout: Basic rules, economic layout, bridge size, calculation of plug point/center of pressure</p>	09 Hrs
Unit – II	
<p>Bending Die: Theory of bending, development of bend, spring back, correcting spring back, bending tools, U bending, V bending, bending on press brake, bending force, different methods of compensation for spring back in V-bending and U-bending.</p> <p>Drawing: Theory of drawing, blank development, calculation of number of stages of drawing, circular draw, draw force calculation, lubrication.</p>	10 Hrs
Unit – III	
<p>Design of Press Tool Elements: Design of die plates, punches, punch holder plates, stripper plates, and calculation of stripping force, bolster plates, pilots, ejectors, shedders, pillar, bush, slender punches, stock guides and feeding device and die sets.</p> <p>Types of Press Tools: Stage tools, progressive tools, compound tools, and combination tools</p>	09 Hrs
Unit – IV	
<p>Mould construction: Design of various injection mould elements, cores, cavities, and Inserts, fitting core and cavity inserts, guide pillars and bushes. Feed systems: Design of gates, runners, impressions, layout, sprue, sprue pullers. Parting Surfaces: Straight, stepped, curved parting surface.</p> <p>Ejector System: Types of ejection, ejector pin, sleeve ejection, plate ejection, blade ejection, air ejection, ejection from fixed half, double ejection, delayed ejection.</p> <p>Cooling System: Need for cooling, cooling solid cores and cavities, insert cooling, cooling long cores, cooling elements, baffles etc., and cooling calculation.</p>	10 Hrs
Unit –V	

Course Outcomes: After going through this course the student will be able to:	
CO1	Explain the necessity of press tool and mould for manufacturing of different tools
CO2	Analyse the design constraints in the given problem
CO3	Apply the design rule for manufacturing of press tools and moulds
CO4	Design of press tools and mould for considering real time issues of Manufacturing, Testing and Assembly

Reference Books:	
1	Paquin J.R. & Crowley, “Die Design Fundamentals”, Industrial Press Inc. 3 rd Ed. 2006. ISBN 13: 9780831131197
2	Ivana Suchy, “Handbook of Die Design”, New York-Mc GRAW-HILL: 2 nd Edition, 2005, ISBN: 9780071462716, 0071462716
3	R. G. W Pye, “Injection Mould Design” Affiliated East-West Press Pvt. Ltd.-New Delhi, 4th Ed, 2000, ISBN: 9788176710107, 8176710105
4	D.V. Rosato, Marlene G. Rosato, “Injection Molding Handbook”, Springer, 3rd Edition, 2000, ISBN: 0792386191, 9780792386193

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit

Semester III						
SURFACE ENGINEERING						
Course Code	:	18 MPD 3E2		CIE Marks	:	100
Credits L: T: P	:	4:0:0		SEE Marks	:	100
Hours	:	48L		SEE Duration	:	3 hrs

Unit – I	
<p>Surface cleaning – classification, and selection of cleaning processes-alkaline cleaning, solvent cold cleaning and vapour degreasing, emulsion cleaning, pickling and descaling</p> <p>Tribology - surface degradation, wear and corrosion, types of wear, roles of friction and lubrication- overview of different forms of corrosion.</p>	09 Hrs
Unit – II	
<p>Surface Engineering of ferrous and non ferrous materials : cast iron, carbon and alloy steels, aluminium and alloys, copper and alloys, magnesium and alloys. Nickel and alloys,</p> <p>Conversion coatings : Chemical and electrochemical polishing, significance, specific examples, phosphate, chromating, chemical coloring, anodizing of aluminum alloys, thermo chemical processes -industrial practices</p>	09 Hrs
Unit – III	
<p>Surface pre-treatment, deposition of copper, zinc, nickel and chromium - principles and practices, alloy plating, electro composite plating, electroless plating of copper, nickel phosphorous, nickel-boron;</p> <p>Environmental protection issues; Environmental regulation of surface engineering , cadmium elimination vapour degreasing alternatives, compliant organic coating.</p>	10 Hrs
Unit – IV	
<p>Sputter technique – Methods, applications, plasma treatments, nitriding, carbonizing, boriding, titanising methods, applications</p> <p>Laser coatings : Laser alloying, sources, variables, methods, applications, specific industrial applications</p>	10 Hrs
Unit – V	
<p>Thermal spraying- techniques, advanced spraying techniques - plasma surfacing, D-Gun and high velocity oxy-fuel processes,</p> <p>Laser surface alloying and Cladding - specific industrial applications, tests for assessment of wear and corrosion behaviour.</p>	10 Hrs

Course Outcomes: After going through this course the student will be able to:	
CO1	Explain various forms of corrosion and basic concepts of surface engineering
CO2	Evaluate the different surface engineering processes with respect to industrial practices
CO3	Apply the knowledge of different spraying techniques in surface engineering
CO4	Analyze tests for assessment of wear and corrosion behaviour.

Reference Books	
1.	Sudarshan T S, 'Surface modification technologies - An Engineer's guide', Marcel Dekker, Newyork, 1989
2.	Varghese C.D, 'Electroplating and Other Surface Treatments - A Practical Guide', TMH, 1993
3.	Strafford, K.N., Datta, P.K., and Gray, J.S., Surface Engineering Practice, Processes, Fundamentals and Applications in Corrosion and Wear, Ellis Harwood (1990).
4.	Mathews, A., Advanced Surface Coatings: A Hand book of Surface Engineering, Spinger (1991).

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Semester III						
ADVANCED MANUFACTURING PRACTICES (Offered by BoS:PG CIM)						
Course Code	:	18 MCM 3E3		CIE Marks	:	100
Credits L: T: P	:	4:0:0		SEE Marks	:	100
Hours	:	48L		SEE Duration	:	3 hrs

Unit –I	
<p>Just in Time Production – Primary purpose, profit through cost reduction, elimination of over production, quality control, quality assurance, respect for humanity, flexible work force, JIT production adapting to changing production quantities, process layout for shortened lead Times, standardization of operation, automation.</p> <p>Sequence and Scheduling Used by Suppliers: Monthly and daily Information. sequenced withdrawal system by sequenced schedule table, problems and counter measures in applying the Kanban system to sub contractors.</p>	10 Hrs
Unit -II	
<p>Toyota Production System-The philosophy of TPS, basic frame work of TPS, Kanbans. determining the number of Kanbans in Toyota Production System, Kanban number under constant quantity withdrawal system, constant cycle, non-constant quantity withdrawal system.</p> <p>Kanban Systems- Supplier Kanban and the sequence schedule for use by suppliers - Later replenishment system by Kanban, Sequenced Withdrawal System and Circulation of the Supplier Kanban within Toyota. production smoothing in TPS, production planning, production smoothing, adaptability to demand fluctuations, sequencing method for the mixed model assembly line to realize smoothed production of goal.</p>	10 Hrs
Unit -III	
<p>Just-in-Time Production with Total Quality Control just in time concept, cutting lot sizes, cutting set-up times, cutting purchase order costs, the JIT cause-Effect chain,</p> <p>Quality Improvements: scrap/quality improvements, motivational effects, responsibility effects, small group improvement activities, withdrawal of buffer inventory, the total quality control concept.</p>	08 Hrs
Unit -IV	
<p>Total Quality Control-Introduction-Total Quality Control concepts, responsibility, learning from the west, TQC concepts categorized, goals, habit of improvement, perfection, basics, process control, easy to see quality control as facilitator, small lot sizes, housekeeping,</p> <p>Scheduling: Capacity scheduling, daily machine checking, techniques and Aids, exposure of problems, fool proof devices, tools of analysis, QC circles,</p>	10 Hrs

TQC in Japanese-owned US electronics plant, TQC in Japanese-owned automotive plants.	
Unit -V	
<p>Plant Configurations: Introduction-ultimate plant configuration, job shop fabrication, frame welding, forming frame parts from tubing, dedicated production lines, overlapped production, the daily schedule, forward linkage, physical merger of processes, adjacency,</p> <p>Material Handling Systems: mixed models, automated production lines, pseudo robots, robots, CAD and manufacturing, conveyors and stacker cranes, automatic quality monitoring</p>	10 Hrs

Course Outcomes: After going through this course the student will be able to:	
CO1	Explain the role of JIT, TPS and TQC strategies in production system
CO2	Analyze the various concepts of modern manufacturing practices
CO3	Apply the concepts of JIT and TPS in real time applications
CO4	Evaluate the various process requirement to decide the plant configuration

Reference Books:	
1	Richard Schonberger, Japanese Manufacturing Techniques, Pearson Higher Education - ISBN:0029291003 1982
2	Yasuhiro Monden, An Integrated Approach To Just In Time, Toyota Production system
3	James Womack, Simon & Schuster, Adult Lean Thinking, ISBN: 0743249275, 2003.
4	James P. Womack, Daniel T Jones, and Daniel Roos, The machine that changed the World - The story of Lean production, Harper Perennial edition published -1991.

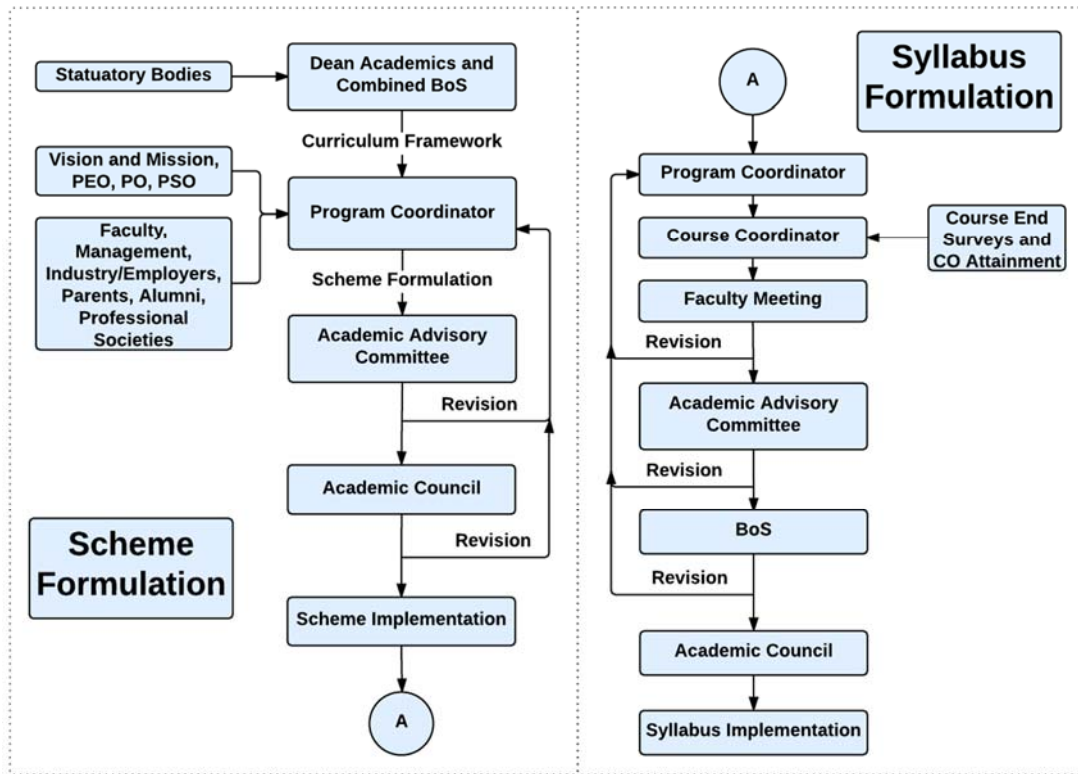
Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

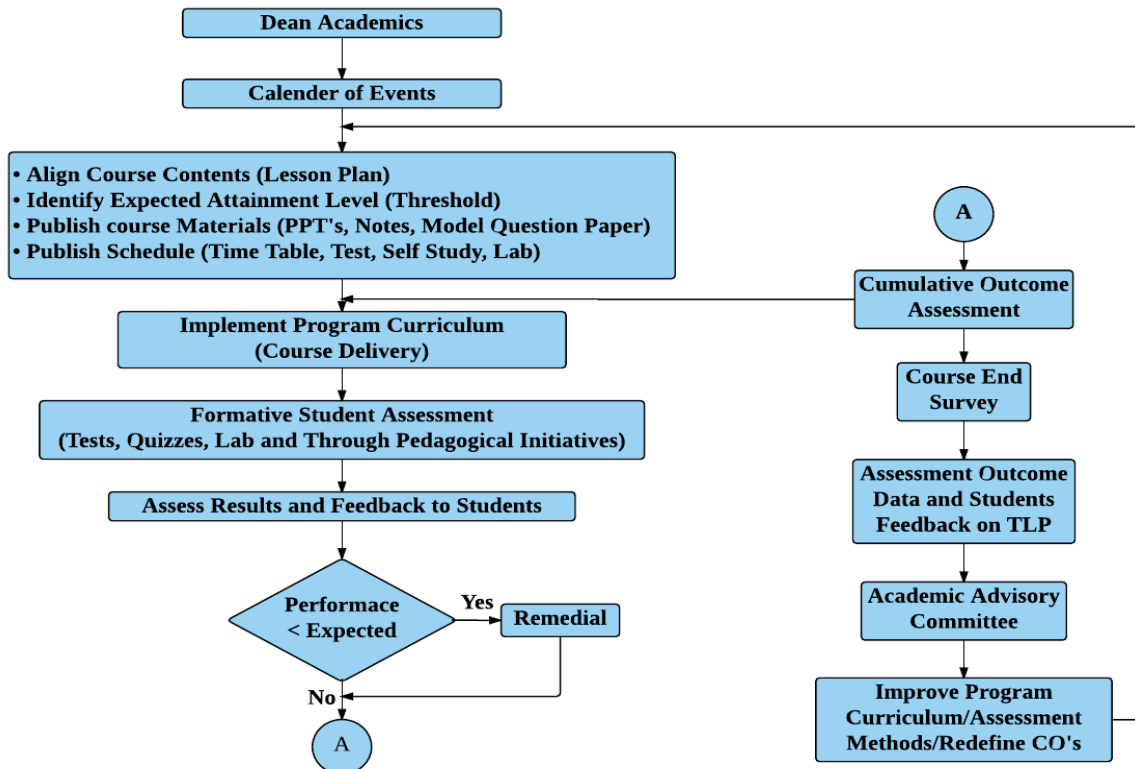
Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

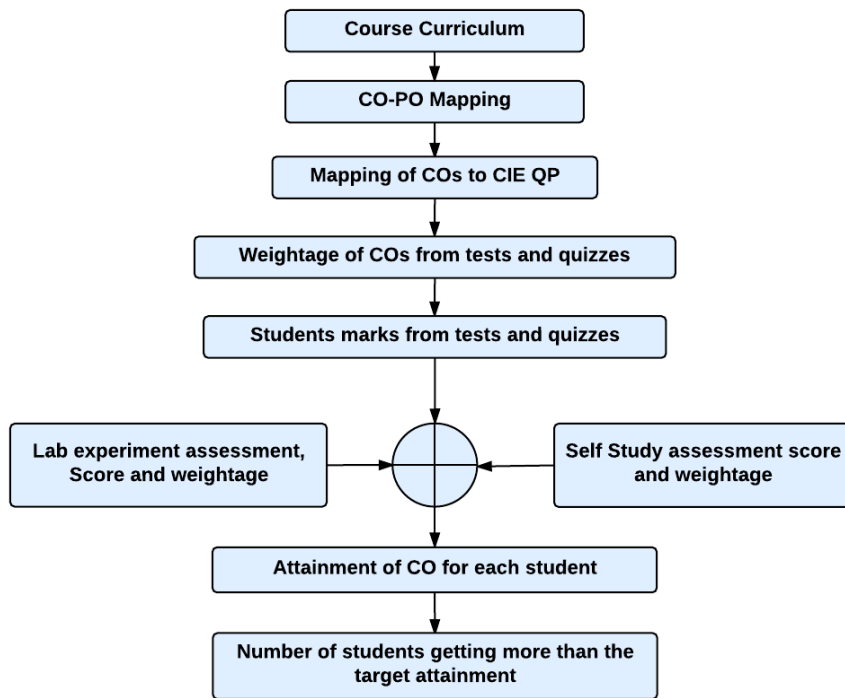
Curriculum Design Process



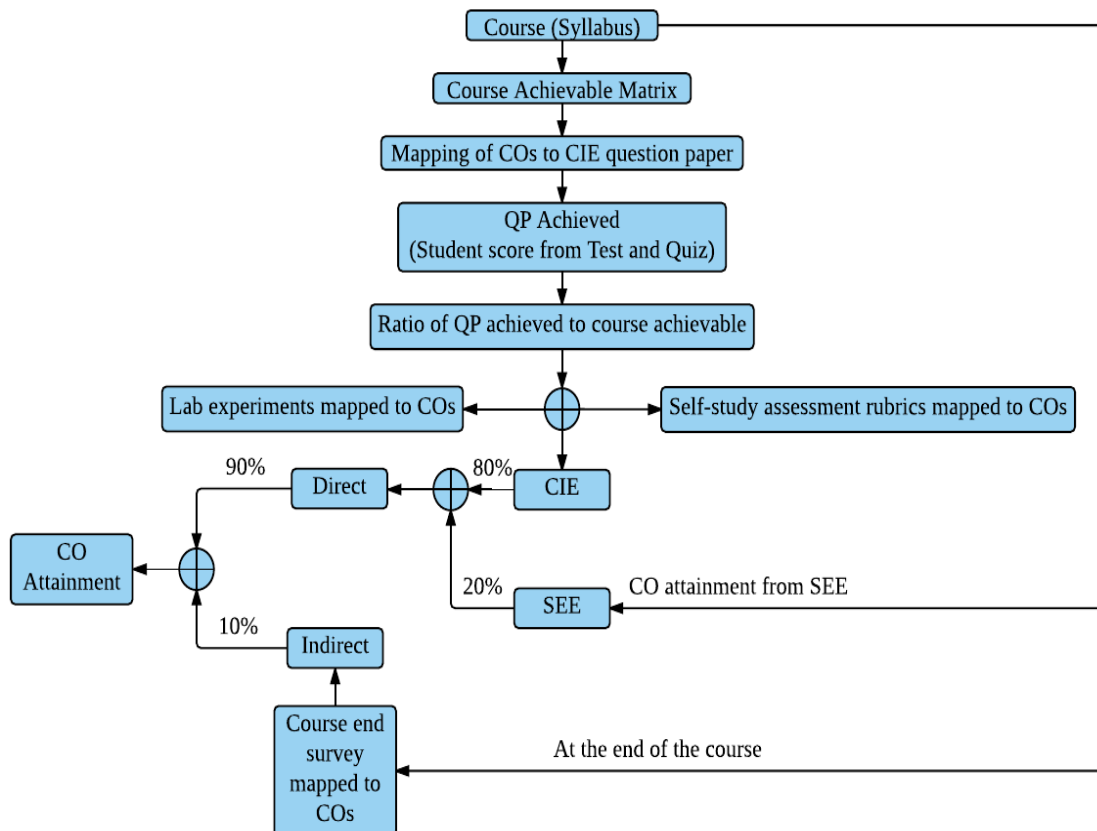
Academic Planning And Implementation



Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process

