Department of Mechanical Engineering

Consolidated Proposal for UG Curriculum

Based on the discussions held in a series of many DFB meetings, following is the proposal for the two UG programs offered by the department.

1) Name of the Programs

4 year B.Tech program in Mechanical engineering (ME1)
4 year B.Tech program in Production and Industrial engineering (ME2)

2) Program structure

a) For ME1 Program:

	L	T	P	TOTAL
Departmental Core	43	4.5	32	64
Programme-linked	9	2	2	12
BS/EAS/HU				55
Departmental Elective				12
Open category				10
Grand Total				**153**

B) For ME2 Program:

	L	T	P	TOTAL
Departmental Core	49	2	31	66
Programme-linked	9	2	2	12
BS/EAS/HU				55
Departmental Elective				12
Open category				10
Grand Total				**155**

3) Department core subjects

a) For ME1 Program:

S. No.	Course Name	L	T	P	Credits
	Departmental Core				
1	Manufacturing Processes I (DC)	3	0	0	3
2	Manufacturing Processes II (DC)	3	0	0	3
3	Manufacturing Lab I (DC)	0	0	2	1
4	Manufacturing Lab II (DC)	0	0	2	1
5	Manufacturing System Design (DC)	3	0	0	3
6	Introduction to Operations Research (DC)	3	0	0	3
7	Engineering Thermodynamics (DC)	3	1	0	4
8	Introduction to Fluid Mech (DC)	3	1	0	4
9	Energy systems and Technologies (DC)	3	0.5	1	4
10	Heat and Mass Transfer (DC)	3	1	0	4
11	Mechanical Engg Drawing (DC)	2	0	3	3.5
12	Solid Mech (DC)	3	1	0	4
13	Kinematics & Dynamics of Machines (DC)	3	0	2	4
14	Design of Machines (DC)	3	0	2	4
15	Control theory and applications (DC)	3	0	2	4
16	ME LAB 1 (DC)	0	0	3	1.5
17	ME LAB II (DC)	0	0	4	2
18	CAM & Automation (DC)	2	0	2	3
19	CAD & Finite Element Analysis (DC)	3	0	2	4
20	BTP I (DC)	0	0	8	4
	DC total	**43**	**4.5**	**32**	**64**

b) For ME2 Program:

S. No.	Course name	L	T	P	credits
	Departmental Core				
1	Near Net Shape Manufacturing	3	0	0	3
2	Welding and Allied Processes	3	0	0	3
3	Metal Forming and Press Tools	3	0	0	3
4	Material Removal Processes	3	0	0	3
5	Production Engineering Lab 1(DC)	0	0	2	1
6	Production Engineering Lab 2 (DC)	0	0	2	1
7	Micro and Nano Manufacturing (DC)	3	0	0	3
8	Manufacturing System Design (DC)	3	0	0	3

9	Introduction to Operations Research (DC)	3	0	0	3
10	Thermal Science for mfg. (DC)	3	1	0	4
11	Metrology and Quality Assurance	3	0	1	3.5
12	Stochastic Modelling and Simulation(DC)	3	0	0	3
13	Mechanical Engg Drawing (DC)	2	0	3	3.5
14	Kinematics & Dynamics of Machines (DC)	3	0	2	4
15	Design of Machines (DC)	3	0	2	4
16	Control theory and applications (DC)	3	0	2	4
17	Industrial Engineering LAB 1 (DC)	0	0	2	1
18	Industrial Engineering Lab 2 (DC)	0	0	2	1
19	CAM & Automation (DC)	2	0	2	3
20	CAD & Finite Element Analysis (DC)	3	0	2	4
21	Solid Mech (DC)	3	1	0	4
22	BTP I (DC)	0	0	8	4
	DC total	**49**	**2**	**31**	**66**

3) Program Linked courses for ME1 and ME2 Programs

Introduction to Statistics (MAL 215): 4 Credits (3-1-0)
Introduction to Material science and engineering (AML 120): 4 Credits (3-0-2)
Numerical methods and computation (MAL 230): 4 Credits (3-1-0)

Total credits: 12

4) Semester schedule

Students of ME1 and ME2 do 34 credits of the Institute core courses in the first two semesters. The schedule of courses for the next six semesters is given below.

Semester Schedule of Courses for B.Tech. (Mechanical Engineering)

Sem	Course-1	Course-2	Course-3	Course-4	Course-5	Course-6	HU courses	Extra courses needed for specialization	Total credits
III	Introduction to Material science and engineering (AML 120) 3-0-2 (4) (PL)	Introduction to Fluid Mechanics 3-1-0 (4) (DC)	Solid Mechanics 3-1-0 (4) (DC)	Engineering Thermodynamics 3-1-0 (4) (DC)	Kinematics & Dynamics of Machines 3-0-2 (4) (DC)	Introduction to Dept. 0-0-2 (Non-graded Core)			20
IV	Design of Machines 3-0-2 (4) (DC)	Manufacturing Processes I 3-0-0 (3) (DC)	Energy systems and Technologies 3-0.5-1 (4) (DC)	Introduction to Statistics (MAL 215) 3-1-0 (4) (PL)	Mechanical Engineering Drawing 2-0-3 (3.5) (DC)		HU1 (4)		22.5
V	Introduction to Operations Research 3-0-0 (3) (DC)	Manufacturing Processes II 3-0-0 (3) (DC)	Heat and Mass Transfer 3-1-0 (4) (DC)	Numerical methods and computation (MAL 230) 3-1-0 (4) (PL)	Introduction to Biology for engineers SBL100 3-0-2 (4) (EAS)	Manufacturing Lab I 0-0-2 (1) (DC)	HU2 (4)		23
VI	Manufacturing System Design 3-0-0 (3) (DC)	Control theory and applications 3-0-2 (4) (DC)	CAD & Finite Element Analysis 3-0-2 (4) (DC)	ME LAB I 0-0-3 (1.5) (DC)	Manufacturing Lab II 0-0-2 (1) (DC)	Environmental science (CEL140) 2-0-0 (2) (EAS)	HU3 (4)	Extra1(4/3)	19.5
VII	CAM & Automation 2-0-2 (3) (DC)	BTP I (4) (DC)	DE1 (3)	OC1(3/4)	ME LAB II 0-0-4 (2) (DC)	DE2 (3)		Extra2(3/4)	18/19
VIII	DE3 (3) or BTP II (6)	OC2 (3)	OC3 (4/3)	DE4 (3) (if no BTP II)			HU4 (3)	Extra 3 (4/3)	16/15
Credits III-VIII									119
Credits I-II									34
Total									153

Semester Schedule of Courses for B.Tech. (Production and Industrial Engineering)

Sem	Course-1	Course-2	Course-3	Course-4	Course-5	Course-6	Course-7	HU courses	Total credits
III	Introduction to Material science and engineering (AML 120) 3-0-2 (4) (PL)	Solid Mechanics 3-1-0 (4) (DC)	Thermal Science for mfg. 3-1-0 (4) (DC)	Kinematics & Dynamics of Machines 3-1-0 (4) (DC)	Introduction to Dept. 0-0-2 (Non-graded Core)			HU1 (4)	20
IV	Design of Machines 3-0-2 (4) (DC)	Metal Forming and Press Tools 3-0-0 (3) (DC)	Near Net Shape Mfg. 3-0-0 (3) (DC)	Introduction to Statistics (MAL 215) 3-1-0 (4) (PL)	Mechanical Engineering Drawing 2-0-3 (3.5) (DC)	Environmental science (CEL140) 2-0-0 (2) (EAS)		HU2 (4)	23.5
V	Introduction to Operations Research 3-0-0 (3) (DC)	Metrology and Quality Assurance 3-0-1 (3.5) (DC)	Welding and Allied Processes 3-0-0 (3) (DC)	Numerical methods and computation (MAL 230) 3-1-0 (4) (PL)	Introduction to Biology for engineers SBL100 3-0-2 (4) (EAS)	Production Engg. Lab I (DC) 0-0-2 (1) (DC)	Stochastic Modelling and Simulation 3-0-0 (3) (DC)		21.5
VI	Manufacturing System Design 3-0-0 (3) (DC)	Control theory and applications 3-0-2 (4) (DC)	CAD & Finite Element Analysis 3-0-2 (4) (DC)	Industrial Engg. LAB I 0-0-2 (1) (DC)	Production Engg. Lab II 0-0-2 (1) (DC)	Material Removal Processes 3-0-0 (3) (DC)	Micro and Nano Mfg. 3-0-0 (3) (DC)		19
VII	CAM & Automation 2-0-2 (3) (DC)	BTP I (4) (DC)	Industrial Engg. LAB II 0-0-2 (1) (DC)	OC1(3/4)			DE2 (3)	HU3 (4)	18/19
VIII	DE3 (3) or BTP II (6)	OC2 (3)	OC3 (4/3)	DE4 (3) (if no BTP II)			DE1 (3)	HU4 (3)	19/18
Credits III-VIII									121
Credits I-II									34
Total									155

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engg
2.	**Course Title** *(< 45 characters)*	Kinematics and Dynamics of Machines
3.	**L-T-P structure**	3-0-2
4.	**Credits**	4
5.	**Course number**	*MEL 211*
6.	**Status** (*category* for *program*)	Core for ME1 and ME2

7.	**Pre-requisites** (course no./title)	AML110

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supercedes any existing course	None

9.	**Not allowed for** (indicate program names)	Nil

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course**	Sudipto Mukherjee, J. K. Dutt,. K. Gupta and other faculty from design group
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

Starting with revolute and linear actuator primitives, kinematics is used to design the geometry of rigid body elements of machines and their interconnections needed to obtain specified output motion in a plane. Rigid body dynamics in the plane is used for estimation of parasitic motion due to mass imbalance. Classical arrangements of rigid body systems to suppress and regulate the resulting motion are discussed. The student is introduced to the characteristics of one and two-body lumped mass systems with compliant elements and some application in design of machines.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

	Kinematic pairs, Kinematic diagram and inversions. Mobility and range of movements. Displacement, velocity and acceleration analysis of planar linkages, graphical and analytical methods. Dimensional synthesis for motion, function and path generation. Force analysis of planar mechanisms. Cam profile synthesis, graphical and analytical method. Gear tooth profile, interference in gears. Gear types, gear trains including compound epicyclic gears. Design of flywheel and governors. Inertia forces and their balancing for rotating and reciprocating machines. Free and forced vibration of SDOF system. Introduction to 2 DOF systems, vibration absorbers.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Kinematic pairs, Kinematic diagram and inversions	2
2	Mobility and range of movements	2
3	Displacement, velocity and acceleration analysis of planar Linkages, graphical and analytical methods	5
4	Dimensional synthesis for motion, function and path generation	5
5	Force analysis of planar mechanisms	3
6	Cam profile synthesis, graphical and analytical methods	5
7	Gear tooth profile, interference in gears	2
8	Gear types, gear trains including compound epicyclic	4
9	Gears dynamic force analysis	1
10	Flywheel, steering mechanisms	2
11	Inertia forces and their balancing for rotating and reciprocating machines	4
12	Introduction to balancing of planar mechanisms	1
13	Free and forced vibration of SDOF and 2 DOF system	6
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Study of mechanisms – identification of links, joints, and DOF, Grashoff and non-Grashoff mechanisms, Inversions, equivalent linkages, mobility, range of movement.	2
2	Velocity and acceleration analysis of planar mechanisms by graphical and analytical methods	2
3	Synthesis of linkages	2
4	Inertia forces in mechanisms, dynamic force and motion analysis	4
5	Synthesis of cam profiles by graphical and analytical methods	4
6	Standard and non-standard involute gear teeth, interference and	2

	undercutting	
7	Kinematic analysis of epicylic gear trains; estimation of holding torque	2
8	Balancing of rotating masses/rotors, Applications of flywheel	4
9	Balancing of reciprocating machinery with emphasis on IC Engines	2
10	Free and forced vibration of single degree freedom system	2
11	Vibration of 2 DOF system, vibration absorber	2
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Theory of Mechanisms and Machines, Amitabha Ghosh, Asok Kumar Mallik
2. Mechanism and Machine Theory, J. S. Rao and R. V. Dukkipati,
3. Mechanisms and Dynamics of Machinery, Hamilton Horth Mabie, Charles F. Reinholtz
4. Theory of Machines and Mechanisms, John Joseph Uicker, G. R. Pennock, Joseph Edward Shigley

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Software for analysis of mechanisms
19.2	Hardware	Experimental setups for demonstration
19.3	Teaching aides (videos, etc.)	Models of automotive systems and components
19.4	Laboratory	
19.5	Equipment	PC
19.6	Classroom infrastructure	LCD , OHP projectors and board
19.7	Site visits	-

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	20
20.2	Open-ended problems	-
20.3	Project-type activity	-
20.4	Open-ended laboratory work	-
20.5	Others (please specify)	-

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engg
2.	**Course Title** *(< 45 characters)*	DESIGN OF MACHINES
3.	**L-T-P structure**	3-0-2
4.	**Credits**	4
5.	**Course number**	
6.	**Status** (*category* for *program*)	Core for ME1 and ME2

7.	**Pre-requisites** (course no./title)	AML140/150, MEP 100, MEP 201 (??)

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	Nil

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** Prof AChawla, Prof S Mukherjee, Dr H Hirani, Dr R K Pandey and other design group faculty	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** This course introduces the student to first level methods to design mechanical machinery. At the end of this course, students shall be able to conceptualize a machine in terms of geometrical requirements and synthesize an assembly of machine components to meet the functional requirements. Students shall be able to size machine components and select material using software.
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Conceptualization a machine in terms of geometrical requirements specified in terms of functional degrees of freedom, degrees of constraints and stiffness. Synthesis of an assembly of machine components to meet the functional requirements. Sizing

	machine components and selecting material through use of free body diagrams, failure theories in static and repeated loading. Design and selection of certain machine elements (i.e. cams, gears, belt-pulleys, bearings, springs, shaft/axle, plates, nuts and bolts, brake/clutch) as exemplars. Case studies (like Gearbox driven by motor using belt drive) through use of parametric software to carry out iteration in the design space.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	**Conceptualizing a machine**: Understanding the need of high performance and efficient machines. Identification of functional requirements. Conceptualizing the geometric shape to fulfill the functions.	5
2	**Force analysis**: Concept of free body diagram. Identification of internal and external forces and moments on each element of conceptualized machine.	3
3	**Rigidity analysis**: Identification of static and dynamic deflections of each element. Understanding the need to additional elements required to improve the rigidity.	2
4	**Solid Modelling**: Making three dimensional model of the conceived machine for verification.	2
5	**Stress analysis**: Estimating various stresses under static and dynamic load conditions. Understanding failure theories.	5
6	Design/select machine components	12
7	**Parameterization**: Tuning the dimensions of machine elements to provide efficient design	2
8	Material and Process selection	4
9	**Assembly of components:** Understanding the effect of tolerances on assembly of conceived machine. Final assembly drawings of machine required to manufacture the conceived machine.	3
10	Case Studies	4
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Introduction of machine elements (Video presentation, physical models, discussion)	6
2	Disassembly of machines	2
3	Measurement and assembly of machine parts	2
4	Fitment and alignment of Bearing	2
5	Conceptualization of machine for given problem	4

6	Identification of machine elements	4
7	Sizing of machine elements	4
8	Material selection	2
9	Project submission & Viva voce examination	2
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Shigley J.E., Mischke C.R., and Budynas R.G., Mechanical Engineering Design, McGraw-Hill, 2004.

Norton R.L.- Machine Design: An integrated approach, 3rd Ediiton

Dieter G. E., and Schmidt L., Engineering Design, MCGRAW-HILL Higher Education, May-2012.

Ashby M F, Material Selection in Mechanical Design, Elsevier, Third Edition, 2005.

http://pergatory.mit.edu/resources/FUNdaMENTALS.html

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	TKSolver, Autodesk Inventor, Material Selector, DFMA.
19.2	Hardware	Physical models of machine elements, PCs / Workstations
19.3	Teaching aides (videos, etc.)	-
19.4	Laboratory	CAGI
19.5	Equipment	PCs / Workstations
19.6	Classroom infrastructure	LCD projectors
19.7	Site visits	Mech equipment manufacturing sites.

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	10
20.2	Open-ended problems	10
20.3	Project-type activity	10
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engg
2.	**Course Title** *(< 45 characters)*	Mechanical Engineering Drawing
3.	**L-T-P structure**	2-0-3
4.	**Credits**	3.5
5.	**Course number**	MEP201
6.	**Status** (*category* for *program*)	Core for ME1 and ME2

7.	**Pre-requisites** (course no./title)	MEP100

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supercedes any existing course	-

9.	**Not allowed for** (indicate program names)	Nil

10.	**Frequency of offering**	☐ Every sem ☐ 1st sem ☒ 2nd sem ☐ Either sem

11.	**Faculty who will teach the course** S.P. Singh, S. Mukherjee,S.V. Modak, A K Darpe, H Hirani, R K Pandey and other mechanical engineering faculty	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)*: Introduce students to convert functional specification of mechanical engineering parts and assembly requirements into manufacturing drawing, in a manner consistent with BIS standards. The course also aims to enable students to interpret manufacturing and assembly drawings.
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)*: Introduction to generation of drawings as a design process for machine assembly. Use of datum planes to locate features and machine elements uniquely in assemblies. Sectioning, dimensioning, notes and version control in drawings.

	Standardized representation of threads, fasteners, welds, bearings, springs and related components. Introduction to limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols. Generation of assembly drawings including sectioning and bill of materials. Evolving details of components from assembly considerations. Detailing of components involving shafts, bearing, pulleys, gears, belts, brackets for assembly. Solid modeling of above assembly and incorporating assembly constraints for animation of motion of machine assemblies.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to Machine Element Drawing, Review of dimensioning, notes. Types of sectioning and use, Need and significance of version control in drawings, methods of recording modifications in typical drawings	3
2	Introduction to generation of drawings as a design process for machine assembly. Use of datum planes to locate features and machine elements uniquely in assemblies.	2
3	Introduction to limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols. Practical examples using industrial drawings	4
4	Standardized representation and types of threads, fasteners, welds.	3
5	Introduction to important machine elements such as bearings (rolling contact/sliding contact), Use of appropriate fits for correct functioning, Representation of springs and related components	2
6	Detailing of components involving shafts, bearing, pulleys, gears, belts, brackets for assembly.	5
7	Generation of assembly drawings using standard modeling software including sectioning and bill of materials. Evolving details of components from assembly considerations	4
8	Solid modeling of above assembly and incorporating assembly constraints for animation of motion of machine assemblies.	4
9	Introduction to Layout, Schematic drawings	1
COURSE TOTAL *(14 times 'L')*		28

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Sketching and drawing of components of Hooke's joint (or similar other assembly) from actual assembly 1. Understanding use of such assembly	6

	2. Study of each component and its role in the functioning 3. Actual sketching with sensitization of adhering to IS standards	
2	Revisiting the drawing in the previous step; acknowledging the variation in dimension (done through actual measurements on set of components across the class); Modifying the drawings to account for the same. Consideration of surface finish and its recording on drawing.	3
3	Exercise on similar other mechanical assembly (screw jack, fuel pump, bicycle frame, etc.)	6
4	Discussion of significance and recording of geometric tolerances on all drawings	3
5	Solid modeling of the components and assembly in Activity 1 and 2	6
6	Making a complete part and assembly drawing (both sheet work and solid model) for a gear box with emphasis on basis and significance of use of variety of machine elements (such as keys, fasteners, retainers, etc). The activity involves animating the functioning of gear-shifter	9
7	Conceptualizing and building a test rig for some functional requirement Variety of simple rigs will be developed on sketch and solid model by group work and will involve use of various machine element decided by their use.	9
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Warren Hammer, Blue Print Reading Basics, 3rd Edition, Industrial Press Inc.
SP-46, Engineering Drawing Practice for Schools and Colleges: Bureau of Indian standards
Luzadder and Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., 11th Edition, 2004
P S Gill, A text book of Machine Drawing, 17th Edition, S K Kataria & Sons, 2012

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	SolidWorks
19.2	Hardware	Good Networked lab with 50 terminals
19.3	Teaching aides (videos, etc.)	-
19.4	Laboratory	CAGIL or similar
19.5	Equipment	Simple machine assemblies, such as gear box, tailstock, clutch assembly, etc.
19.6	Classroom infrastructure	LCD , OHP projectors
19.7	Site visits	-

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	2
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engg
2.	**Course Title** *(< 45 characters)*	Control theory and applications
3.	**L-T-P structure**	3-0-2
4.	**Credits**	4
5.	**Course number**	MEL312
6.	**Status** (*category* for *program*)	Core for ME1 and ME2

7.	**Pre-requisites** (course no./title)	First year Mathematics courses

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	50-60% with EEL301 and CHL261
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	Nil

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** S.P. Singh, J.K. Dutt, S. Mukherjee, S.K. Saha, S.V. Modak	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)*: The objective of the course is to introduce methods of feedback control of dynamic systems primarily using classical control approaches
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)*: Introduction; Fourier and Laplace transforms; Mathematical Modeling of simple physical systems; Transfer function; Block diagrams; Signal flow graph; Transient response analysis using Laplace transform; Frequency response; Design/performance specifications in time and frequency domain; Steady state error and error constants;

	Proportional, integral, derivative, PD and PID control; Sensors and actuators for temperature, pressure, flow and motion control systems; Realization of standard controllers using hydraulic, pneumatic, electronic, electro-hydraulic and electro-pneumatic systems; Stability; Routh's criterion; Nyquist stability criterion, Bode plots; Control system design using Root Locus and Frequency response; Lead and lag compensation; Gain margin, Phase margin; Introduction to Modern control: State space representation; Control with state feedback; Review of applications of control in: Machine tools, Aerospace, Boiler,Engine Governing, Active vibration control

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction Fourier and Laplace transforms description of systems	2
2	Mathematical Modeling of flow, heat transfer, electrical, pneumatic and vibration systems; Linearization; Linear system; Transfer function models; Block diagram representation; Signal flow graph	6
3	Transient response analysis using Laplace transform; First and second order systems and their characteristics; Higher order systems;Steady state error and error constants; Design/performance specifications in time domain	4
4	Characteristics of feedback control systems: Disturbance rejection,sensitivity; Standard feedback controllers: on/off; Proportional, integral, derivative, PD and PID	3
5	Sensors and actuators for control systems: sensors for temp., pressure, flow and motion control, accelerometers, gyros, encoders, solenoids, potentiometers, tachogenerator, hydraulic amplifier, DC motor, stepper motors etc.	4
6	Realization of standard controllers using hydraulic, pneumatic, electronic, electro-hydraulicand electro-pneumatic systems	3
7	Stability of control systems; poles/ zeros, complex plane; Routh's criterion; Delay and its influence on control system performance	2
8	Frequency response, Bode plots; Nyquist plot, Nyquist stability criterion	4
9	Control system design Root Locus: Root locus method of design; Lead and lag compensation.	4
10	Control system design using Frequency response:Frequency domain specifications: Gain margin, Phase margin; Correlation of Frequency and time domain specifications; Frequencydomain design: Lead and lag compensator design using Bode Plots	3
11	Introduction to Modern control: State space representation; Pole placement; state observer; Control with state feedback	5

12	Review of applications of control in: Machine tools, Aerospace, Boiler, Engine Governing, Active vibration control	2
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Dynamic response of first/second order physical systems	6
2	Pneumatic/hydraulic/electronic controllers	4
3	Control of various parameters such asspeed, temperature, level, pressure	8
4	Computer based control	2
5	Simulation of control systems using SIMULINK	4
6	Design of control systems using MATLAB Control System Toolbox	4
7		
8		
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Katsuhiko Ogata, Modern Control Engineering, Prentice Hall, 2010
M. Gopal, Control Systems: Principles and Design, Tata McGraw-Hill Education, 2002
I.J. Nagrath, Control Systems Engineering, New Age International, 2006
Norman S. Nise, Control Systems Engineering, 6th Edition, John Wiley & Sons,.2010
Nakra B.C., Introduction to Automatic Control Engineering, New Age Publishers

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	MATLAB and its control system Tool box
19.2	Hardware	Experimental setups about control systems; PCs/Computer lab
19.3	Teaching aides (videos, etc.)	-
19.4	Laboratory	Instrumentation
19.5	Equipment	Experimental setups about control systems; PCs/Computer lab
19.6	Classroom infrastructure	LCD , OHP projectors
19.7	Site visits	-

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	20
20.2	Open-ended problems	40
20.3	Project-type activity	
20.4	Open-ended laboratory work	10
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engg
2.	**Course Title** *(< 45 characters)*	CAD AND FINITE ELEMENT ANALYSIS
3.	**L-T-P structure**	3-0-2
4.	**Credits**	4
5.	**Course number**	
6.	**Status** (*category* for *program*)	Core for ME1 and ME2

7.	**Pre-requisites** (course no./title)	MEL 311, AML140 / AML150 for UG

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	MEL414
8.2	Overlap with any UG/PG course of other Dept./Centre	AML705, 706, 710 (course should be mutually exclusive w.r.t these courses)
8.3	Supercedes any existing course	MEL414

9.	**Not allowed for** (indicate program names)	Nil

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course** A. Chawla, S Mukherjee, H Hirani	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** The primary objective of the course is to introduce the student to working with discretised geometry in design of mechanical components and representations of shapes. It is intended to be a first course on Finite Element Techniques and CAD tools like surface and solid modeling.
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Introduction and overview. Need and Scope of Computer Aided Machine Design. Role

	of Geometric Modelling, FE and Optimization;2D and 3D Geometric transformations and projections. The Viewing pipeline; Geometric modeling; Modelling of curves, cubics, splines, beziers and b-splines, NURBS; Modeling of surfaces; Modeling of solids–b-rep, CSG, octree, feature based modelin; Introduction to the Finite Element Method, principle of potential energy; 1D elements, Derivation of Stiffness and Mass matrices for a bar, a beam and a shaft, FEA using 2D and 3D elements; Plain strain and plain stress problems, plates / shell elements; Importance of Finite element mesh, Automatic meshing techniques; Interfacing with CAD software. Introduction to Thermal analysis, Dynamic analysis using eigen values, and Non linear analysis; Limitations of FEM

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction and overview. Need and Scope of Computer Aided Machine Design. Role of Geometric Modelling, FE and Optimization;	2
2	2D and 3D Geometric transformations, projections	3
3	The Viewing Pipeline	1
4	Geometric modeling: Modelling of cubic curves	4
5	Modeling of Bezier and B-Spline Curves	4
6	Modeling of surfaces: B splines, NURBS;	3
7	Modeling of solids–b-rep, CSG, octree, feature based modeling.	5
8	Introduction to the Finite Element Method, principles of minimization of potential energy; Application to Thermal problems	5
9	1D elements, Derivation of Stiffness and Mass matrices for a bar, a beam,	4
10	FEA using 2D and 3D elements; Plain strain and plain stress problems, plates / shell elements;	5
11	Importance of Finite element mesh, Automatic meshing techniques.	3
12	Introduction to FE based vibration analysis using eigenvalues, introduction to Non linear analysis; Limitations of FEM	3
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Labs involving modeling using curves / NURBS	6
2	1D / beam problems using FE Solvers and convergence	2
3	2D problems (plates and shells) using FE solver	4
4	3D problems using FE	4
5	Problems involving interfacing CAD and FE packages	4
6	Optimization problems involving FE analysis	4
7	Determining natural frequencies and mode shapes in a simple	2

	structure	
8	Lab test	2
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Mortenson M. E., Geomtric Modeling, John Wiley and Sons, 1985

Roger D. F., Mathematical Elements of Computer Graphics, Tata Mc Graw Hill Publishing, 1990

Hearn D. & Baker, Principles of Computer Graphics, Prentice Hall, 1997

Chandrupatla T., An Introduction to FE in Engineering, Prentice Hall, 1991.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	ANsys / Abaqus, ProEngineer / SOlidWorks / Catia, Matlab / Visual C++
19.2	Hardware	PCs / Workstations
19.3	Teaching aides (videos, etc.)	-
19.4	Laboratory	CAGI
19.5	Equipment	PCs / Workstations
19.6	Classroom infrastructure	LCD , OHP projectors
19.7	Site visits	Mech equipment manufacturing sites.

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	10
20.2	Open-ended problems	10
20.3	Project-type activity	
20.4	Open-ended laboratory work	10
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	ENGINEERING THERMODYNAMICS
3.	**L-T-P structure**	3-1-0
4.	**Credits**	4
5.	**Course number**	
6.	**Status** (*category* for *program*)	CORE FOR ME1

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	ME2

10.	**Frequency of offering**	☐ Every sem ☒ 1st sem ☐ 2nd sem ☐ Either sem

11.	**Faculty who will teach the course** S.R. Kale, A. Gupta, S. Jain and other faculty from thermal engineering	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The purpose of this course is to present the fundamentals of classical thermodynamicsto students of all branches of Engineering. This basic course deals with laws of thermodyamics, energy and its relation to matter and lays the foundation for subsequent courses in Fluid Mechanics, Heat Transfer, Energy systems & technologies and other thermal engg courses such as Turbomachinery, Refrigeration And Air Conditioning, Power Plant Engg. etc.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Introduction: microscopic and macroscopic points of view. Basic concepts and definitions – system, boundary, equilibrium, steady state, zeroth law,

	temperature scale. Work and heat – definition and applications; various forms of work. Thermodynamic properties of a pure substance – saturated and other states, real gases, compressibility chart. The First Law of Thermodynamics for control mass/ volume, Internal Energy, Enthalpy, The SSSF and USUF Processes. Second Law – corollaries, Carnot cycle. Clausius inequality, entropy. Irreversibility and exergy analysis. Thermodynamic Relations. Vapor power cycles – Rankine cycle and its modifications. Brayton/ Otto/ Dual cycles. Vapor compression refrigeration cycle.Thermodynamics of non-reacting mixtures, psychrometry.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction: microscopic and macroscopic points of view, applications to diverse engineering systems, historical perspective	3
2	Basic concepts and definitions – system, boundary, equilibrium, steady state, zeroth law, temperature scale.	3
3	Work and heat – definition and applications; various forms of work	3
4	Thermodynamic properties of a pure substance – saturated and other states, real gases, compressibility chart	4
5	The First Law of Thermodynamics, First law for control mass/ volume, Internal Energy, Enthalpy, The SSSF and USUF Processes, Applications to simple systems	6
6	2nd Law – corollaries, Carnot cycle. Clausius inequality, entropy	7
7	Irreversibility and exergy analysis	3
8	Thermodynamic Relations	1
9	Vapor power cycles – Rankine cycle and its modifications.	4
10	Air standard cycles – Brayton/ Otto/ Dual cycles. Vapor compression refrigeration cycle.	4
11	Thermodynamics of non-reactive mixtures, psychrometry	4
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

Problem solving on various topics of Thermodynamics covered in the lectures

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

- Fundamentals of Thermodynamics -- Sonntag R.E., Borgnakke C. & Van Wylen C. J.
- Fundamentals of Engineering Thermodynamics -- Moran M. J. & Shapiro H. N.
- Engineering Thermodynamics -- Nag P.K

Thermodynamics : An Engg. Approach -- Cengel and Boles

Fundamentals of Thermal-Fluid Sciences-- Y A Cengel & R H Turner.

- Engineering Thermodynamics -- Rogers G.F.C. & Mayhew Y.R.

Engineering Thermodynamics - A Generalised Approach -- Dhar P.L.

Fundamentals of Engineering Thermodynamics -- Howell J.R.

- Engineering Thermodynamics -- An Introductory Test -- Spalding D.B. and Cole E.H.
- Thermodynamics : Fundamentals for Applications – J P O'connell & J M Jaile.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	INTRODUCTION TO FLUID MECHANICS
3.	**L-T-P structure**	3-1-0
4.	**Credits**	4
5.	**Course number**	MEL 160
6.	**Status** (*category* for *program*)	core

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	no
8.2	Overlap with any UG/PG course of other Dept./Centre	AML 150, AML 170, CHL 231, CHL 204
8.3	Supercedes any existing course	AML 160

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** All faculty from Thermal group and any interested faculty from Applied Mechanics	
12.	**Will the course require any visiting faculty?**	no

13. Course objective *(about 50 words)***:**

The objectives of this course are to (a) introduce concepts of engineering through the fundamental laws of conservation and accounting, and (b) teach and emphasize the role of fluid flows in real life engineering problems. Additionally, project and problem based learning would be emphasized with a departure from conventional lecture and guided problem solving approach followed so far.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

Introduction: scope, methods of analysis (system vs. volume), Fluid as a continuum, Eulerian/Lagrangian description, Newton's law of viscosity.

Fluid Statics: Hydrostatic force on submerged surfaces, Buoyancy and stability, Fluids in rigid-body motion.

	Flow kinematics: Flow lines, vorticity and circulation. Integral flow analysis: Reynolds transport theorem, conservation of mass, linear and angular momentum for inertial and accelerating control volumes, conservation of energy, Bernoulli's equation. Differential analysis of fluid motion: Conservation of mass, stream function for 2D incompressible flow, fluid translation, rotation and deformation, conservation of momentum, Navier-Stokes equations, incompressible inviscid flows, potential flow. Dimensional analysis and similitude: Dimensionless groups, scaling, non-dimensionalization. Viscous flows: fully developed laminar and turbulent pipe flows, head loss, boundary layer concept, flow separation, comparison of laminar and turbulent velocity profiles, streamlining and implications. Compressible flow: speed of sound, the Mach cone, stagnation properties, critical conditions, isentropic flows and converging-diverging nozzles.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction: Definition and Scope, Philosophy of Problem Solving, Conservation and Accounting, Examples of Real Life Problems, Mathematical Representation (Continuum, Eulerian/Lagrangian Description)	2
2	Fluid Properties: Case Studies to highlight their Role	1
3	Simple Statics:Hydrostatic force on submerged surfaces, Buoyancy and stability, Fluids in rigid-body motion, Differential Analysis, Case Studies: Gates, Containers/Reservoirs	2
4	Kinematics: Streamlines, pathlines, streaklines and their use in design of nozzles and diffusers, vorticity and circulation, Case studies: design of blender/mixer/chopper, swirlers, in aerodynamics.	3
5	Reducing the degrees of freedom of an engineering system using dimensional analysis, Dimensionless groups, Examples.	2
6	Development of Generalized Mathematical Framework: Integral vs. Differential Analysis, advantages and applications (highlighted using case studies)	6
7	Potential Flow theory and its application to geometric design using examples (such as airfoils)	2
8	Flow Classification: Internal vs External, Vector (incompressible) vs Vector & Scalar (compressible) dominated flow fields, Absolute (laminar) vs Statistical (turbulent) Flows	3
9	Internal Flows: Concept of fully developed laminar flow in 2D geometries, laminar vs turbulent flows, turbulent velocity profiles in fully developed pipe flow, importance of friction factor, case studies	6
10	External Flows: the boundary layer concept (for flat plate & cylinder), Flow separation, Similarity solution, Simplification of Navier-Stokes through dimensional analysis, comparison of laminar and turbulent velocity profiles and design inferences, Friction and Form drag	10
11	Compressible Flows, Speed of sound, Mach cone, stagnation properties, critical conditions, area variation in isentropic flow, isentropic flow in converging-diverging nozzle, Case Studies	4
12	Perspective and Closure	1
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

Tutorials will comprise of exercise and problem solving sessions based on lecture modules listed above.

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	NA	
2		
3		

4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		0

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1) P.J. Pritchard, A.T. McDonald and R.W. Fox, Introduction to Fluid Mechanics 7th ed., John Wiley & Sons (2012).
2) J. D. Anderson, Fundamentals of Aerodynamics, 5th ed., Tata McGraw Hill (2010).
3) F.M. White, Fluid Mechanics, 7th ed., Tata McGraw Hill (2011).

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Freeware potential flow packages.
19.2	Hardware	NIL
19.3	Teaching aides (videos, etc.)	Free Videos on fluid kinematics & Turbulence, Homsy videos, etc.
19.4	Laboratory	
19.5	Equipment	Collection of Real Life Fluid Devices
19.6	Classroom infrastructure	LCD & Black Board.
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	Simulation & Video based learing - 30%

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	THERMAL SCIENCE FOR MANUFACTURING
3.	**L-T-P structure**	3-1-0
4.	**Credits**	4
5.	**Course number**	
6.	**Status** (*category* for *program*)	Core course for ME2 students

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	Thermodynamics, Heat and Mass Transfer (50%)
8.2	Overlap with any UG/PG course of other Dept./Centre	Transport Phenomena (ChE) (50%)
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	ME1
10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem
11.	**Faculty who will teach the course** Prof S Kohli, Prof S Jain, Prof S R Kale, Prof A Ray and other thermal engineering faculty	
12.	**Will the course require any visiting faculty?**	No
13.	**Course objective** *(about 50 words)***:** To present the required fundamentals of thermal science with application examples to students of manufacturing.	
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Overview and the importance of the knoweldge of thermal science in manufacturing processes. Basics of thermodynamics: closed and open	

	systems, work and heat. First law of thermodynamics for control mass and control volume. Second law of thermodynamics. Irreversibilities and examples of irreversibilities in manufacturing. Introduction to transport phenomena : various modes of transport of momentum, energy and mass- diffusion and advective transport. Convective heat and mass transfer - Concept of momentum, thermal and concentration boundary layers; relevant correlations. Radiation heat transfer. Blackbody radiation. Gray and diffuse surfaces. Surface radiation.Case studies of manufacturing processes involving application of the above concepts.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to relevance of thermal sciences to manufacturing processes; various aspects of thermal sciences - thermodynamics and transport phenomena (fluid mechanics, heat transfer, mass transfer)	1
2	Basic concepts in thermodyamics - thermodnamics as a study of energy and its transformation; system-surroundings, control volume, state, properties, work, heat and first law for closed and open systems. Control volume approach and statement of first law for a rate process and hence SSSF and USUF processes; concept of equation of state, examples from manufacturing processes to demonstrate application of first law of thermodynamics.	7
3	Second law of thermodynamics - different statements of second law; definition of entropy; reversible and irreversible processes; mathematical statement of second law for a closed system and a SSSF process. Various causes of irreversibilities; examples of practical situations in manufacturing processes with irreversibilities	5
4	Introduction to transport phenomena : various modes of transport of momentum, energy and mass- diffusion and advective transport; General equation for transport of these quantities (without detailed derivation) Diffusion: Newton's law of viscosity, Fourier's law, Fick's law; Examples of 1-D steady state heat transfer and mass transfer problems in manufacturing involving only diffusion; formulation of a 2-D steady state diffusion problem	8
5	1-D transient diffusion problems (involving semi-infinite media) in heat and mass transfer; lumped mass analysis in heat transfer; relevant non-dimensional numbers; melting and solidification.	. 5
6	Convective heat and mass transfer - Concept of momentum, thermal and concentration boundary layers; relevant non-dimensional numbers; Correlations for different types of flow : Laminar and turbulent flow regimes, internal and external flows with examples for different configurations; Natural convection	7
7	Radiation Heat Transfer: Emissive power, intensity, Blackbody radiation and surface properties. Gray and diffuse bodies. Configuration factors. Concept of radiation in an enclosure without participating medium. Relation for exchange of radiation between two gray and diffuse surfaces. (with suitable examples)	7
8	Case studies of manufacturing processes involving application of the above concepts	2
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

Numerical problem solving and some case studies of manufacturing processes.

17. Brief description of laboratory activities

Module no.	Experiment description	No. of

		hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Bird, Stewart and Lightfoot, Transport Phenomena, John Wiley.
2. Borgnakke, Van Wylen and Sonntag, Fundamentals of Thermodynamics, John Wiley.
3. Incropera and Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley.
4. Cengel, Heat Transfer, McGraw-Hill.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	ENERGY SYSTEMS AND TECHNOLOGIES
3.	**L-T-P structure**	3-0.5-1
4.	**Credits**	4
5.	**Course number**	MEL241
6.	**Status** (*category* for *program*)	Core for ME1 students

7.	**Pre-requisites** (course no./title)	MEL140 or equivalent

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	No
8.2	Overlap with any UG/PG course of other Dept./Centre	ESL714 (>50%)
8.3	Supercedes any existing course	MEL241

9.	**Not allowed for** (indicate program names)	None

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** Amit Gupta, Sanjeev Jain, Sangeeta Kohli, M R Ravi, PMV Subbarao and other faculty of Thermal Engineering	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The objectives of the course are:

- To expose students to Energy Systems and Technologies: Sources, Conversion techniques, Utilization, Storage and Environmental Impact
- To train them to solve problems in the underlying concepts that govern the working of these systems
- To expose them to the systems hardware and their working.

The course is envisaged to combine lectures on conventional energy conversion and utilization systems and on newer and emerging technologies with hardware exposure and term-paper assignments.

The course is expected to follow a 3-0.5-1 format with 7 weeks of practicals for hardware exposure, and the remaining 7 weeks of tutorials.

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Energy sources : Fuels : Fossil fuels, Nuclear fuels, Direct Solar, Indirect solar - Biomass, Ocean, Tidal, Hydro, Wind etc. Energy demand/ Growth/ economics ; Fuel upgradation: gasification of coal and biomass; biogas Energy conversion: Direct Conversion: Solar PV, Fuel Cells, Thermoelectric Conversion Thermal to electric: IC Engines, Gas and Steam Turbines; Electromechanical conversion; Hydraulic turbines Chemical to Thermal: Combustion and stoichiometry Energy utilization : Refrigeration, HVAC, Desalination, Polygeneration; pumps and compressors Energy storage : Thermal/ Mechanical/ Electric/ Chemical Environmental Impact : Air/ water/ soil / nuclear waste

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Energy sources : Fuels : Fossil fuels, Nuclear fuels, Direct Solar, Indirect solar - Biomass, Ocean, Tidal, Hydro, Wind etc. Energy availability/ collection/ demand/ Growth/ economics; Fuel upgradation: gasification of coal and biomass; biogas	2
2	Combustion, steam generators, thermochemical / Biochemical conversion of biomass, coal gasification, nuclear reactors	6
3	Conversion of thermal to Mechanical Energy: IC Engines, Gas, Vapor and combined power systems	8
4	Turbomachinery for power generation: Steam, Gas, Wind and Hydraulic turbines	6
5	Direct Conversion to electricity : Solar PV, Fuel Cells, Thermoelectric Conversion	4
6	Recap of Psychrometry, Refrigeration & HVAC systems	6
7	Energy Utilization/ efficiency: Polygeneration - Desalination, heat, power, hydrogen, biogas, chemicals etc.	2
8	Turbomachinery for energy utilization: Compressors and pumps	2
9	Energy Storage and transport: Thermal/ Mechanical/ Electric/ Chemical	4
10	Environmental Impact : Air/ water/ soil / nuclear waste	2
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

7 weeks of tutorial activity: problem solving on lecture material on energy systems and technologies

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Laboratory Exposure: Fuels and combustion	2
2	Laboratory exposure: IC engines	2
3	Laboratory exposure: Refrigeration and Airconditioning	2
4	Laboratory exposure: Turbomachinery	4
5	Visits to renewable energy systems	4
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		14

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Applied Thermodynamics -- Eastop T.D. & Mc Conkey A.
2. Principles of Energy Conversion -- Culp A.W.
3. Jochen Fricke and Walter Borst, Essentials of energy technology, Wiley-VCH, 2013

Engineering Thermodynamics -- Rogers G.F.C. & Mayhew Y.D.
4. Fundamentals of Thermodynamics -- Borgnakke C., Sonntag R.E. and Van Wylen J.C.
5. Engineering Thermodynamics - A Generalised Approach -- Dhar P.L.

Refrigeration and Airconditioning:
6. Refrigeration and Air Conditioning -- Stoecker W.F. & Jones J.W.
7. Refrigeration and Air Conditioning -- Arora C.P.

IC Engines:
8. Internal Combustion Engines -- Ganesan V.

Gas Turbines and Power Plants:
9. Gas Turbines -- Ganesan V.
10. Power Plant Engineering -- Nag P.K.
11. Power Plant Engineering -- El Wakil
Renewable Energy
12. Solar Energy -- Sukhatme S.P.
13. Renewable energy engg and technology - VVN Kishore (ed.)
14 Fuel cell fundamentals- R. O'Hayre, S.W. Cha, W.Colella, F. Prinz

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	NA
19.2	Hardware	Systems of IC engines, Refrigeration and A/C, Turbomachinery, Renewable Energy Systems
19.3	Teaching aides (videos, etc.)	Working principles of systems
19.4	Laboratory	as above
19.5	Equipment	as above
19.6	Classroom infrastructure	with audiovisuals and projection
19.7	Site visits	Choose from: Power Plant, AC plant, DG set, Gasification unit, Solar collectors and PV panels, Solar Energy Centre, etc.

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	If time permits
20.2	Open-ended problems	If time permits
20.3	Project-type activity	If time permits: term paper can be included
20.4	Open-ended laboratory work	If time permits
20.5	Others (please specify)	NA

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	HEAT AND MASS TRANSFER
3.	**L-T-P structure**	3-1-0
4.	**Credits**	4
5.	**Course number**	
6.	**Status** (*category* for *program*)	Compulsory course for ME1 students

7.	**Pre-requisites** (course no./title)	Thermodynamics, Mechanics of Fluids

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	CHL 251
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	ME2
10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Dr P Talukdar, Dr B Premachandran, Prof M R Ravi, Prof S Jain and other thermal engineering faculty	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

To introduce students to fundamentals of heat and mass transfer processes with adequate application examples.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

- Modes of heat transfer, energy carriers and continuum approximation. Mechanisms of mass transfer. Unified view of momentum, heat and mass transfer.
- Conduction: Fourier's law, heat diffusion equation, 1-D steady state conduction in extended surfaces, heat generation, lumped capacitance and 1D

	transient models, semi-infinite wall. Diffusion mass transfer in 1D: steady state and transient. • Convection: Forced and free convection - mass, momentum and energy conservation equations, scaling analysis and significance of non-dimensional numbers, thermal boundary layers, heat transfer in external and internal laminar and turbulent flows, and use of correlations. Convective mass transfer. Boiling and condensation: physical phenomena and correlations. • Heat exchanger types and analysis: LMTD and effectiveness-NTU method. • Radiation: properties, Laws, view factor, 3-surface network for diffuse-gray surfaces. Gas radiation.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Modes of heat transfer, energy carriers and continuum approximation. Mechanisms of mass transfer. Unified view of momentum, heat and mass transfer.	3
2	Conduction: Fourier's law, heat diffusion equation, 1-D steady state conduction in different coordinate systems, effect of heat generation	3
3	Heat conduction in extended surfaces, fin characterization	2
4	Lumped capacitance and 1D transient models, semi-infinite wall. Diffusion mass transfer in 1D: steady state and transient.	4
5	Convection: Forced and free convection - mass, momentum and energy conservation equations, scaling analysis and significance of non-dimensional numbers	4
6	Thermal boundary layers, heat transfer in external and internal laminar and turbulent flows, Natural convection	8
7	Convective mass transfer	2
8	Boiling and condensation: physical phenomena and correlations.	4
9	Heat exchanger types and analysis: LMTD and effectiveness-NTU method.	4
10	Radiation: properties, Laws, view factor, 3-surface network for diffuse-gray surfaces. Gas radiation	8
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

Primarily numerical problem solving on different topics covered in the lectures.

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
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10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Fundamentals of Heat and Mass Transfer, Incropera and Dewitt, Sixth Edition, John Wiley.
2. Heat Transfer, Y Cengel, Mcgraw-Hill.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	10%
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	MANUFCTURING PROCESSES I
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	CORE FOR ME1

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	With three core courses of ME2 (30% each)
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	MEL232

9.	**Not allowed for** (indicate program names)	ME2

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** D Ravi Kumar, S Aravindan, S Ghosh	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The objective of the course is to impart fundamental knowledge on primary manufacturing processes such as casting, joining, forming and powder metallurgical processes and their applications. The course also covers analysis of the processes.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

CASTING: Sand casting, Gating system and its design, Riser design and its placement, Melting, Pouring and Fluidity, Solidification of pure metals and alloys, Casting defects, Inspection and testing. Other casting processes, advantages and applications.

WELDING: Shielded metal arc welding, other arc welding processes like TIG, MIG and SAW processes, Types of metal transfer in arc welding, Gas welding and Gas cutting, Resistance welding, Solid state welding processes, Brazing,

	Soldering and their applications, Surfacing and its applications. FORMING: Plastic deformation of metals, stress-strain relationships, Yield criteria, Hot working and Cold working, Friction and lubrication in metal working, Analysis of bulk forming and sheet metal forming processes. Unconventional forming processes. Powder Metallurgy: Powder production methods, compaction and sintering. Applications of powder metallurgy.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Sand casting process, Patterns and pattern allowances, Moulding sand properties and their testing methods, Mould preparation, Core and Coremaking.	3
2	Gating system and its design, Riser design and its placement,	3
3	Melting, Pouring and Fluidity, Solidification of pure metals and alloys, Casting defects, Inspection and testing.	3
4	Other casting processes.	4
5	Shielded metal arc welding, other arc welding processes like GTAW, GMAW and SAW processes, Types of metal transfer in arc welding	6
6	Gas welding and Gas cutting	1
7	Resistance welding, Solid state welding processes	3
8	Brazing, Soldering and their applications, Surfacing and its applications.	3
9	Plastic deformation of metals, stress-strain relationships,Yield criteria	3
10	Hot working and Cold working, Friction and lubrication in metal working.	4
11	Analysis of bulk forming and sheet metal forming processes. Unconventional forming processes.	7
12	Powder Metallurgy: Powder production methods, compaction and sintering. Applications of powder metallurgy.	2
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
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10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Manufacturing Engineering and Technology – Kalpakjian (Addison Wesley)
2. Modern Manufacturing Processes - Groover
3. Principles of Metal Casting – RW Heine, CR Loper and PC Rosenthal (Tata-McGraw Hill).
4. Welding – AWS Handbooks

5. Mechanical Metallurgy (Part IV) – G E Dieter (Tata-McGraw Hill).
6. Metal Forming: Processes and Analysis-B. Avitzur
7. Industrial Metal Working Processes- G.W. Rowe
8. Manufacturing Science – A. Ghosh and A.K. Mallik (East West Press).

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	Req
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	Req
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	MANUFCTURING PROCESSES II
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	CORE

7.	**Pre-requisites** (course no./title)	MANUFCTURING PROCESSES I

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	MEL233

9.	**Not allowed for** (indicate program names)	ME2

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Prof P V Rao, Dr S. Ghosh, N Bhatnagar	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

1. To Learn the basic mechanics of metal machining
2. To Learn the basics of various Machine Tools
3. To learn the various Non coneventional Machining Methods & Metrology and quality aspects during machining

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Introduction to Metal Machining and Machine Tools, Geometry of cutting tools, Mechanics of Machining including force and temperature generation, Methods of measurment of forces and temperature (experimentally and analytically), Tool wear mechanisms and tool life criteria, Basic concepts of cost and economics of machining

Various types of machine tools and their development with regard to productivity & accuracy requirements, Workholding and tool holding devices

	for machine tools Introduction to non conventional machining processes and understanding basic mechanisms of material removal in such processes Introduction to metrology, Dimensional Inspection, Inspection by measurment, Limit gauging, Design of Limit gauges, Surface quality inspection, Feature inspection

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to Machining and Machine Tools	1
2	Basics of tool geometry including nomenclature of cutting tools	3
3	Mechanics of Machining - Oblique and orthogonal machining operations, chip formation processes during machining	3
4	Cutting forces in orthogonal machining using Merchant's Circle Diagram	3
5	Fundamentals of heat transfer mechanisms during machining and cutting temperature generation during machining	3
6	Various methods of determining cutting forces and temperature	3
7	Methods for controlling cutting temperature and improving surface finish during machining	2
8	Various tool materials and their uses, Tool wear mechanisms and tool life and control of tool wear	4
9	Basics of Grinding process and Economics of Machining	3
10	Introduction to Non Conventional machining processes and mechanisms of material removal in these processes	5
11	Basics of Machine Tools	5
12	Introduction to Metrology, Standardization, dimensional measurement, limits, fits and tolerances,Various gauges and inspection techniques, Measurement of Surface Roughness, Feature Inspection	7
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
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4		
5		
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7		
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10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Fundamentals of Metal Machining and Machine Tools – G. Boothroyd, (Taylor and Francis, 3rd Edition)
2. Metal Cutting Principles – M. C. Shaw (Oxford University Press)
3. Advanced Methods of Machining – J.A.McGeough (Springer International Edition)
4.Galyer, J.F.W. & Shotbolt, C.R., "Metrology for Engineers", Cassell & Co. Ltd., London

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	Req
19.3	Teaching aides (videos, etc.)	Req
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	Req
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	10%
20.2	Open-ended problems	10%
20.3	Project-type activity	30%
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	MATERIALS REMOVAL PROCESSES
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	CORE

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	MEL234

9.	**Not allowed for** (indicate program names)	ME1

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** S. Ghosh, P V Rao, N. Bhatnagar	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

1. To learn various material removal processes and chip removal mechanisms
2. To learn and analyse non traditional machining and ultra precision machining processes
3. To understand the basic machine tools and the kinematic structures

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Introduction to various material removal processes, Nomenclature and geometry of cutting tools, Mechanics of Conventional and Non Conventional Machining including force,temperature, surface integrity. Methods of measurment of forces, temperature and surface finish (experimentally and analytically), Tool wear mechanisms and tool life criteria, Basic concepts of cost and economics of machining.

Various types of machine tools and their structures, Workholding and tool

	holding devices for machine tools. Ultraprecision machining and grinding methods and the machine tools used for such processes. Manufacturing of micro tools, Nano-finishing of materials using advanced machining methods

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to Machining and Machine Tools	1
2	Geometry of cutting tools and various tool designation systems and their interrelationship	4
3	Mechanisms of chip formation and Mechanics of Machining - Orthogonal and Oblique machining operations	2
4	Analysis of Cutting forces during orthogonal machining using Merchant's Circle Diagram	3
5	Fundamentals of heat transfer during machining and analysis of cutting temperature generation during machining	3
6	Various methods of determining cutting forces and temperature	2
7	Methods for controlling cutting temperature and improving surface integrity aspects during machining	4
8	Advanced tool materials and their uses, Tool wear mechanisms and tool life, measurements of tool wear	3
9	Basics of abrasive machining processes	2
10	Introduction to Advanced machining processes, Analysis of the processes such as EDM, ECM, ECGM, LBM etc and modelling for material removal in those processes	8
11	Basics of Machine Tools and structures of general purpose machine tools	4
12	Ultraprecision machining and grinding processes, their applications and requirements of machine tools for ultraprecision machining, Fabrication of micro tools and nano surface generation using the advanced machining processes. Cost estimation for adopting such processes, Safety considerations and impact on environment of the various machining processes	6
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Fundamentals of Metal Machining and Machine Tools – G. Boothroyd, (Taylor and Francis, 3rd Edition)
2. Metal Cutting Principles – M. C. Shaw (Oxford University Press)
3. Advanced Methods of Machining – J.A.McGeough (Springer International Edition)
4. Micromachining of Engineering Materials - J. A. McGeough, CRC Press
5.Nano and micromachining, J. Paulo Davim, Mark J. Jackson, John Wiley and Sons
6. Non Traditional Machining Process - G F Bendict, Marcel Dekker.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	Req
19.3	Teaching aides (videos, etc.)	Req
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	Req
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	20%
20.2	Open-ended problems	20%
20.3	Project-type activity	40%
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	NEAR NET SHAPE MANUFACTURING
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	MEL
6.	**Status** (*category* for *program*)	Core ME2

7.	**Pre-requisites** (course no./title)	None

8.	**Overlap of contents with any** *(give course number/title)*	
8.1	existing UG course(s) of the Department/Centre	
8.2	proposed UG course(s) of the Department/Centre	None
8.3	approved PG course(s) of the Department/Centre	None
8.4	UG/PG course(s) from other Departments/Centers	None
8.5	Equivalent course(s) from existing UG course(s)	None

9.	**Not allowed for** (indicate program names)	ME 1

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Alternate year

11.	Faculty who will teach the course ALL PRODUCTION FACULTY	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The objective of the course is to introduce the fundamental knowledge on the processes used for manufacturing near net shapes. This also introduces the applications of such processes.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Introduction and fundamentals of Casting of complicated shapes: automotive components, casting of light alloys – Aluminum, magnesium and Titanium alloys

Injection moulding: Thermoplastics, thermoset plastics and composites – processing

	methodologies. Powder Metallurgy: fabrication routes, powder size determination – micro and nano level, powder consolidation routes, compacting, sintering, hot pressing, sintering, hot iso static pressing, field assisted sintering technologies. Advances in near net shape manufacturing: Metal Injection moulding, Laser engineered net shaping.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Cooling curves, solidification behaviour of metal and alloy, dendritic, equi-axed and refined grain growth	2
2	Introduction and fundamentals of metal flow	5
3	Permanent mold, pressure die casting, squeeze casting, centrifugal casting, continuous casting, stir casting, investment casting	10
4	Gating system, risering system, casting design: Metallurgical consideration, design consideration, economical consideration	5
5	Application of CAD\CAM in foundry. Casting of complicated shapes: automotive components, casting of light alloys – Aluminum, magnesium and Titanium alloys.	5
6	Injection moulding: Thermo and thermo set plastics and composites – processing methodologies – extrusion, injection moulding, die design, and defects of the components, compression, transfer , rotational and blow moulding	4
7	Powder fabrication routes, powder size determination – micro and nano level, powder consolidation routes, compacting, sintering, hot pressing, sintering, hot iso static pressing, field assisted sintering technologies, powder metallurgy and applications.	5
8	Metal injection moulding and applications	2
9	Laser engineered net shaping and applications	4
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

Not Applicable

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
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7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

1. Manufacturing Engineering and Technology – Kalpakjian (Addison Wesley)
2. Principles of Metal Casting – RW Heine, CR Loper and PC Rosenthal (Tata-McGraw Hill)
3. Manufacturing Science – A. Ghosh and A.K. Mallik (East West Press)
4. ASM handbook on casting technology
5. Materials and processes in manufacturing – E.Paul degarmo- wiley 2002
6. Fundamentals of Modern Manufacturing: Materials, Processes & Systems by Mikell P. Grover, Mikell P. Groover –Prentice Hall USA.
7.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	LCD PROJECTOR FACILITY
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date : (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Department of Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	MANUFACTURING SYSTEM DESIGN
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	Core Course

7.	**Pre-requisites** (course no./title)	Programme Linked course "Probability and Statistics" MAL140

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	
10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem
11.	**Faculty who will teach the course** M S Kulkarni, N. Bolia, Kiran seth	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The objective is to introduce students to the basics of manufacturing system modeling and design.

On completing the course, students should be able to understand the dynamics of manufacturing systems and use quantitative approaches to develop simple models for evaluating the performance of various elements of a manufacturing system.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Manufacturing strategy, Manufacturing flexibility, Manufacturing complexity, Investment decisions using life cycle costing, System reliability and maintenance models, Economic design of quality control plans, Single and mixed model assembly line balancing, Shop floor scheduling algorithms, Lot sizing and inventory control models, Performance modeling of manufacturing systems, Production control mechanisms like Kanban, CONWIP and POL2

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to the course and overview of manufacturing systems	4
2	Manufacturing strategy	2
3	Manufacturing flexibility	1
4	Manufacturing complexity	1
5		
6	Basic decision making models Investment decisions under uncertainty using lifecycle costing models	2 2
7	System reliability and maintenance models	5
8	Economic design of quality control plans	3
9	Single and mixed model assembly lines	3
10	Shop floor scheduling algorithms	3
11	Economic lot sizing Inventory control models	2 4
12	Performance modeling of production lines Production control mechanisms like Kanban, CONWIP and PLOCA Futuristics approaches for manufacturing system control	4 4 2
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
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8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Miltenburg J, Manufacturing Strategy: How to Formulate and Implement a Winning Plan / Edition 2, Taylor & Francis, 2005.

James L. Riggs J. L., Bedworth D. D., Randhawa S. U., Engineering Economics, Edition 4, Tata Mcgraw Hill, 2004.

Ebeling C. E., An Introduction to Reliability and Maintainability Engineering, McGraw Hill India, 2000.

Askin R.G., Goldberg J. B., Design and Analysis of Lean Production Systems, John Wiley and Sons (Asia), 2003.)

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	Yes
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD projector
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	80%
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	INTRODUCTION TO OPERATIONS RESEARCH
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	Core

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	MEL221

9.	**Not allowed for** (indicate program names)	
10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem
11.	**Faculty who will teach the course** Nomesh B. Bolia, Kiran Seth, A.D. Gupta	
12.	**Will the course require any visiting faculty?**	Yes

13. Course objective *(about 50 words)*:

To introduce students to basic modeling and tools of Operations Research. The course will enable the students to appreciate how to model real life situations of various domains, and use mathematical tools to optimize decision making.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Introduction to Modeling, Linear Programming - Formulation, Solution methods including Simplex, Primal-Dual, Integer Programming - Formulation, Solution methods, Introduction to Dynamic Programming, Software Tools and Case Studies.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction and Motivation	2
2	Linear Programming: Formulation	3
3	Solution of Linear Programming Problems: Graphical Method	1
4	Simplex Method: Geometry, Tableau	4
5		
6	Revised Simplex Method	3
7	Primal-Dual: Introduction, Basic Theory, Formulations	2
8	Integer Programming: Formulation, Binary Formulations with Examples	4
9	Solution of Integer Programming Programming: Branch and Bound	3
10	Dynamic Programming: basics, formualtion, solution	6
11	Software tools (excel, cplex)	2
12	Applications/Case Studies	12
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Hillier, F. S. and Lieberman, G.J. Introduction to Operations Research. McGraw-Hill. 7th Edition. 2001.

Taha, H. Operations Research: An Introduction. Pearson Education. 8th Edition. 2007.

Wolsey, L.A. and Nemhauser, G. L. Integer and Combinatorial Optimization. John Wiley & Sons. 1999.

Interfaces - A Journal of the Institute for Operations Research and Management Science (INFORMS), subscribed by IIT Delhi, available on IITD library website.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Excel with Solver Plugin

19.2	Hardware	Laptop
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: Jan 2, 2014 (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	STOCHASTIC MODELING AND SIMULATION
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	MEL324
6.	**Status** (*category* for *program*)	Core

7.	**Pre-requisites** (course no./title)	MAL140 or equivalent

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	MEL770, MEL250

9.	**Not allowed for** (indicate program names)	
10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem
11.	**Faculty who will teach the course** Nomesh B. Bolia, Kiran Seth	
12.	**Will the course require any visiting faculty?**	Yes

13. Course objective *(about 50 words)*:

To introduce students to stochastic modeling and simulation. The course will enable the students to appreciate how to model uncertainty in systems, and find analytical or simulation based solutions.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Overview of Probability Basics, Introduction to Discrete Time Markov Chains (DTMC), Transient and Limiting analysis of DTMC, Introduction to Continuous Time Markov Chains (CTMC), Transient and Limiting analysis of DTMC, Applications, Discrete Event Simulation - Introduction, Generation of Random Variables, Simulation modeling thorugh case studies.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction and Motivation	2
2	Basics of Probability and Random Variables	2
3	DTMC: Introduction and Transient Analysis	5
4	DTMC: Limiting Behavior	4
5		
6	CTMC: Introduction and Evolution	2
7	CTMC: Transient and Limiting Analysis	6
8	Applications	4
9	Simulation: Introduction and Generations of Random Variables	3
10	Simulation Modeling - with examples, software tools	14
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Ross, Sheldon. Introduction to Probability Models. 10th Edition. Elsevier, 2010.

Kulkarni, V. G. Modeling Analysis, Design and Control of Stochastic Systems. Springer-Verlag New York, Inc. 1999.

Interfaces - A Journal of the Institute for Operations Research and Management Science (INFORMS), subscribed by IIT Delhi, available on IITD library website.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Anylogic Simulation Software
19.2	Hardware	Laptop
19.3	Teaching aides (videos, etc.)	

19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: Jan 2, 2014 (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	METAL FORMING AND PRESS TOOLS
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	CORE FOR ME2

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	30% WITH MFG-1 FOR ME1
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	MEL 234

9.	**Not allowed for** (indicate program names)	ME1

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** D. RAVI KUMAR AND OTHER INTERESTED FACULTY OF ME DEPT.	
12.	**Will the course require any visiting faculty?**	NO

13. Course objective *(about 50 words)*:

The objective of the course is to impart knowledge on fundamentals of important metal forming processes and to make the students understand the mechanics of the processes by mathematical analysis and their application in real situations by solving numericals. The course also covers the equipment and tools used in metal forming and recent developments including unconventional forming processes.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Mechanical behaviour of metals and alloys in plastic deformation, Stress-strain relationships, Yield criteria, Fundamentals of plasticity, Tensile properties, Flow stress and flow curves, Fundamentals of metal forming processes, Strain rate and temperature in metal working, Hot working, Cold working and annealing, Analysis of forming processes like forging, rolling, extrusion, wire

	drawing and sheet metal forming by slab method, Equipment and tools used in metal forming operations, Types of presses, different types of dies and their design aspects, Unconventional forming processes.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Elastic and plastic deformation of metals and alloys, Stress-strain relationships	2
2	Tensile properties, Flow stress and constitutive equations	3
3	Fundamentals of plasticity, Yield criteria	4
4	Fundamentals of metal working, Classification	2
5	Temperature and strain rate in metal forming, Hot deformation	2
6	Cold working and annealing	2
7	Theory and analysis of buk forming processes	12
8	Theory and analysis of sheet metal forming processes	8
9	Metal forming equipment	2
10	Metal forming tools, different types of dies	3
11	Unconventinal forming processes	2
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Manufacturing Processes for Engineering Materials- S. Kalpakjian and S. Schmid
2. Metal Forming: Processes and Analysis-B. Avitzur
3. Industrial Metal working Processes- G.W. Rowe
4. Mechanical Metallurgy – G.E. Dieter

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	

19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	WELDING AND ALLIED PROCESSES
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	ME2

7.	**Pre-requisites** (course no./title)	None

8.	**Overlap of contents with any** *(give course number/title)*	
8.1	existing UG course(s) of the Department/Centre	30% OVERLAP
8.2	proposed UG course(s) of the Department/Centre	None
8.3	approved PG course(s) of the Department/Centre	None
8.4	UG/PG course(s) from other Departments/Centers	None
8.5	Equivalent course(s) from existing UG course(s)	None

9.	**Not allowed for** (indicate program names)	ME 1
10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Alternate year
11.	Faculty who will teach the course : Sunil Pandey, S Aravindan	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The objective of this course is to introduce the fundamental concepts of various welding and allied processes. The students will understand the science behind the joining processes and associated applications.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Principles of arc welding, basic physics of arc and flame, Gas welding and Gas cutting, manual metal arc welding, GTAW, GMAW. Metal transfer mechanisms in arc welding, Weld bead characterization, Electrogas and electro slag welding, Resistance

	welding, Heat flow characteristics and metallurgical changes in fusion welding, Solid state welding processes, Radiant energy welding processes, Brazing, Soldering and their applications, Joint design, welding symbols and Joint evaluation through destructive and non destructive testing methods, welding defects, causes and remedies, residual stress and distortion. Plasma cutting, surfacing and plasma spray forming, surfacing applications. Advances in welding.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Principles of arc welding, basic physics of arc and flame, Gas welding and Gas cutting, manual metal arc welding, Arc welding power sources, power source characteristic curves, flux covering, different types of electrodes and their applications,	8
2	GTAW, GMAW and SAW processes and their recent variants. Plasma-arc welding process: transferred and non- transferred arc welding and their applications, plasma cutting, surfacing and plasma spray forming.	8
3	Weld bead characterization, Electrogas and electro slag welding, Resistance welding: spot, seam, projection, percussion, flash butt welding, heat balance, electrode life, RSW applications,	6
4	Heat flow characteristics and metallurgical changes in fusion welding,	2
5	Solid state welding processes-Cold welding, ultrasonic welding, friction and friction stir, explosive and diffusion bonding- ceramic-metal joints	5
6	Radiant energy welding processes - equipment -electron beam welding (EBW) - laser beam welding (LBW) - applications of EBW and LBW.	3
7	Brazing, Soldering and their applications	2
8	Joint design, welding symbols and Joint evaluation through destructive and non destructive testing methods,	4
9	welding defects, causes and remedies	2
10	Hybrid welding processes and applications	2
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

Not Applicable

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
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COURSE TOTAL *(14 times 'P')*	

18. Suggested texts and reference materials

1. AWS Handbook (Vol 1-5), American welding society, Miami, USA.
2. ASM Handbook – welding, brazing and soldering, vol 6,
3. Howard B Cary, Modern welding technology, 6th Ed., Prentice Hall USA, 2004

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	LCD Projector
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date : (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	CAM&AUTOMATION
3.	**L-T-P structure**	2-0-2
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	Core

7.	**Pre-requisites** (course no./title)	MFG-I & MFG-II for ME1; Material Removal processes(ME2)

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Sunil Jha, P M Pandey, P V M Rao	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

Industrial automation is at the heart of modern industries. The automation in modern manufacturing industries is achieved by introduction of automation implementation technologies using like hydraulics, pneumatics and PLCs with mechanical systems. Computer numerical control is used to manufacture mathematically defined geometries. Use of group technology, process planning and automated material handling technologies adds to achieve automation. The syllabus of the course has been designed to develop basic understanding about automation implementation technologies and computer aided manufacturing practiced in modern manufacturing industries.

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Automation need and types of automation, economics of automation, FMS, CIM. Basics of electro-mechanical automation technologies, Circuit design and applications of hydraulic, pneumatic, electro-pneumatic, electro-hydraulic and programmable logic control (PLC) systems. Numerical control, NC and CNC hardware and programming, Machine controls, HMI design and implementation, DNC system, Control engineering in production systems: open loop and closed loop control systems, Automated material handling technologies, Group technology, Computer aided process planning, Inspection automation and reverse engineering, Rapid prototyping and tooling concepts and applications, virtual manufacturing.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Automation need and types of automation, economics of automation, Computer Integrated Mfg.	2
2	Basics of automation implementation methodologies, Circuit design and applications of hydraulic and pneumatic controls	4
3	Electro-hydraulic and Electro-pneumatic System design	4
4	Programmable Logic Control (PLC) hardware and programming.	5
5	NC and CNC hardware, Machine interface programming, HMI Design	5
6	Automated material handling technologies	3
7	Group technology, Computer aided process planning	2
8	Inspection automation and reverse engineering,	1
9	Rapid prototyping and tooling concepts and applications, virtual manufacturing.	2
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		28

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Basic Pneumatics Experiments	6
2	Electro-Pneumatics Experiments	4
3	Electro-Hydraulic Experiements	4
4	Programmable Logic Controller Experiments	6
5	Machine interface Programming and HMI Design	4
6	Motion Control Experiments	4
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Anthony Esposito, Fluid Power with Applications, 6th edition, Pearson Prentice Hall, 2009
2. John W. Webb, Ronald A Reis, Programmable Logic Controllers - Principles and Applications, 5th Edition, Pearson Education, 2008
3. John R. Hackworth, Frederick D. Hackworth Jr, Programmable Logic Controllers - Programming Methods and Applications, 7th impression, Pearson Education, 2011
4. Mikell P. Grover, Automation, Production Systems, and Computer Integrated Manufacturing, 3rd Edition, Prentice Hall India, 2008

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Automation Studio, Hydraulic and Pneumatic Simulation, Electropneumatic Simulation, PLC Programming, Motion control softwares
19.2	Hardware	Pneumatic Trainers, Hydraulic Trainers, Electrohydraulic Trainers, Electropneumatic Trainers, PLC Trainers, HMI, Motion Controllers, CNC Machines
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	Automation Laboratory
19.5	Equipment	Trainers and CNC Machines
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	40%
20.2	Open-ended problems	20%
20.3	Project-type activity	30%
20.4	Open-ended laboratory work	10%
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	MICRO- AND NANO-MANUFACTURING
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	
6.	**Status** (*category* for *program*)	ME2

7.	**Pre-requisites** (course no./title)	MFG-I & MFG-II for ME1; Material Removal processes for ME 2

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NONE
8.2	Overlap with any UG/PG course of other Dept./Centre	NONE
8.3	Supercedes any existing course	NONE

9.	**Not allowed for** (indicate program names)	
10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem
11.	**Faculty who will teach the course** P V Madhusudhan Rao,.S.Aravindan	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

MEMS,NEMS and nanotechnology have already found many applications in Mechanical Engineering and are projected to be of greater relevance to mechanical systems in future . Objective of the course is to expose students with emerging manufacturing techniques for producing micro and nano level products.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

An overview of micro and nano mechanical systems and their applications in Mechanical Engineering, MEMS Microfabrication methods, Silicon Micromachining methods, Laser,Electron and Ion beam micromachining methods, Mechanical Micromachining techniques, Nanomanufacturing methods, nanomaterials and nano metrology.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	An overview of micro and nano mechanical systems and their applications in Mechanical Engineering - Nano-machines, Nano-mechanics, Nano-metrology, Nano-tribology, Nano-fluidics, Nano-manufacturing	5
2	MEMS Microfabrication - manufacture of substrates, diffusion, thermal oxidation, ion implantation, rapid thermal processing, optical lithography, photoresists, non-optical photolithography, vacuum processes and plasmas, and etching processes, thin film manufacturing using physical vapor deposition, chemical vapor deposition, epitaxial growth processes.	7
3	Silicon Micromachining - anisotropic wet chemical etching, wafer bonding, dry plasma etching, surface micromachining.	5
4	Laser Micromachining methods	2
5		
6	Mechanical Micromachining - abrasive microgrinding, micro milling, micro electro discharge machining, micro electro chemical machining, nano grinding, focused ion beam and electron beam machining	8
7	Fabriaction of nano materials and nano crystalline materials Characterization techniques such as SEM, SPM,AFM,TEM,.	7
8	Micro- nano patterned surfaces for functional devices, application potential of micro and nano structured surfaces	6
9	Recent advances in micro & nanofabrication	2
10		
11		
12	COURSE TOTAL(14 TIMES ' L'	42
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
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6		
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8		
9		
10		
COURSE TOTAL *(14 times 'P')*		14

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. K Eric Drexler, Nanosystem: Molecular Machinery, Manufacturing and Computation, John Wiley.
2. P Rai-Choudhuri, Handbook of Microlithography, Micromachining and Microfabrication, SPIE Press
3. J A McGeough and Joseph McGeough, Micromachining of Engineering Materials, Marcel Dekkar.
4. V K Jain, Introduction to micromachining, Narosa Publications 2011.
5.Stefano Cabrini and Satoshi Hawata, Nano fabrication hand book – CRC press 2012.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	MECHANICAL ENGINEERING LABORATORY I
3.	**L-T-P structure**	0-0-3
4.	**Credits**	1.5
5.	**Course number**	
6.	**Status** (*category* for *program*)	DC for ME1

7.	**Pre-requisites** (course no./title)	Fluid Mech, Solid Mech, Thermo, Kinematics, Energy Systems

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	
10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem
11.	**Faculty who will teach the course**	
12.	**Will the course require any visiting faculty?**	

13. Course objective *(about 50 words)*:

To introduce to the students the methodology of experimentation through the process of defining a set of objectives, conceptualizing a rig, putting it together in a flexible laboratory environment, carrying out the measurements, Calibration of sensors and analysis leading to the defined objectives. The students will also be introduced to uncertainty analysis of the results.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Experiments pertaining to applications of the concepts learnt in the theory courses of Fluid Mech, Solid Mech, Thermodynamics, Kinematics and dynamics and Energy Systems

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
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5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Examples: Study of trajectories of cricket ball/golf ball etc. vis-à-vis the shape and surface characteristics of the balls;	6
2	Heat treatment of steel bars and measurement of properties like strength, hardness, wear resistance etc. . Also thermal analysis of the heat treatment process. Also measurment of different properties of various materials.	9
3	Evaluation of stresses due to drag forces on an object;	6
4	Measurment of pressure and temperatures in an IC engine/compressor with measurement of the cylinder dimensions and estiimating mass flow rate, study of relevant mechanisms like CAM, slider crank etc.	9
5	First and second law analysis of variety of systems	9
6	Dynamics of rotaing systems	3
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		42

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. E.O. Doeblin, Measurement Systems – Application and Design, McGraw Hill.
2. J.W. Dally, W.F. Riley and K.G. McConnell, Instrumentation for Engineering Measurements, John Wiley & Sons.
3. B.C. Nakra and K.K. Chaudhry, Instrumentation, Measurement and Analysis, Tata McGraw Hill.
4. Experimental Methods for Engineers - J P Holman, McGraw-Hill, 2007.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engineering
2.	**Course Title** *(< 45 characters)*	MECHANICAL ENGINEERING LABORATORY II
3.	**L-T-P structure**	0-0-4
4.	**Credits**	2.0
5.	**Course number**	
6.	**Status** (*category* for *program*)	DC for ME1

7.	**Pre-requisites** (course no./title)	Mech Eng Lab I, HMT, Control Theory, Design of Machines

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Sangeeta Kohli, S Mukherjee, A K Darpe, A Gupta and other faculty of Mechanical Engg Department	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** Experiments with Practical systems involving Engineering Concepts

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** The expeiments would involve full or partial fabrication of setups and then taking readings and analysis of its behavior, instead of using ready made setups. The knowledge gained in control engineering course would also be used for setting up computerised measurements using Data acquisition cards

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Examples: Setting up an on-off controller for a thermal system and related measurements.	8
2	Experiments with a domestic mixer including measurement of pressure variations, temperature rise in the slurry, thermal analysis of motor and importance of fins	12
3	Experiments with a refrigeration system in heating and cooling mode to find COP, measurement of system noise levels, study of mountings.	8
4	Experiments using power window mechanism of a car	8
5	Automotive Transmissions : Analysis and conceptualising new design	12
6	Presentations and experience sharing	8
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		56

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. E.O. Doeblin, Measurement Systems – Application and Design, McGraw Hill.
2. J.W. Dally, W.F. Riley and K.G. McConnell, Instrumentation for Engineering Measurements, John Wiley & Sons.
3. B.C. Nakra and K.K. Chaudhry, Instrumentation, Measurement and Analysis, Tata McGraw Hill.
4. Experimental Methods for Engineers - J P Holman, McGraw-Hill, 2007.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Solid Modelling Software, Matlab
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	Flexible Laboratory facilities
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	30%
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	30%
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	MANUFACTURING LAB I
3.	**L-T-P structure**	0-0-2
4.	**Credits**	1
5.	**Course number**	MEP
6.	**Status** (*category* for *program*)	CORE FOR ME1

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	Production Engg. lab I course of ME2 (60%)
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	Prac part of MEL 232

9.	**Not allowed for** (indicate program names)	ME2
10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem
11.	**Faculty who will teach the course** D.Ravikumar, S.Aravindan, N.Bhatnagar, S.Ghosh	
12.	**Will the course require any visiting faculty?**	No
13.	**Course objective** *(about 50 words)*: The objective of the course is to give hands on exposure on primary manufacturing processes such as casting, joining, forming and powder metallurgical processes and their applications.	
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)*: Experiemnts on casting, joining, forming, injection molding and powder metallurgical processes.	

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Introduction to lab and safety	2
2	Sieve analysis and testing of moulding sand	2
3	Determination of fluidity of molten metal by spiral test	2
4	Study of die casting and centrifugal casting	2
5	Analysis of weld bead profiles in shielded metal arc welding : varying polarity, current and weld speed Weld bead analysis and microstructure analysis in GMAW process .Edge preparation and GTAW process with and without filler metal	2 2 2
6	a.Processing of polymers into product by Injection molding b.Process parameter control in Injection molding process	2 2
7	Drop forging of a spanner and study of power hammer	2
8	Determination of formability in deep drawing and stretch forming.	2
9	Determination of springback in bending of different materials.	2
10	Compaction and sintering of powder metallurgical samples and evaluation	2 2
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Manufacturing Engineering and Technology – Kalpakjian (Addison Wesley)
2. Modern Manufacturing Processes - Groover

3. Principles of Metal Casting – RW Heine, CR Loper and PC Rosenthal (Tata-McGraw Hill).
4. Welding – AWS Handbooks
5. Mechanical Metallurgy (Part IV) – G E Dieter (Tata-McGraw Hill).
6. Metal Forming: Processes and Analysis-B. Avitzur
7. Industrial Metal Working Processes- G.W. Rowe
8. Manufacturing Science – A. Ghosh and A.K. Mallik (East West Press).

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	Yes
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	Yes
19.5	Equipment	Yes
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	MANUFCTURING LAB II
3.	**L-T-P structure**	0-0-2
4.	**Credits**	1
5.	**Course number**	
6.	**Status** (*category* for *program*)	CORE

7.	**Pre-requisites** (course no./title)	MANUFACTURING LAB I

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	ME2
10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** Prof P V Rao, Dr S. Ghosh, N Bhatnagar	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)***:**
The objective of the course is to give hands on exposure of machining and measurement/Metrology and their applications.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**
Experiments on machining and metrology.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	INTRODUCTION TO THE LAB AND SAFETY RELATED ISSUES	2
2	STUDY OF CHIP FORMS DURING TURNING UNDER VARIOUS PROCESS PARAMETRIC CONDITIONS	2
3	ROLE OF MACHINING PROCESS PARAMETERS ON SURFACE FINISH	2
4	TEMPERATURE MEASURMENT DURING TURNING PROCESS	2
5	EFFECT OF DRESSING PARAMETERS ON SURFACE FINISH DURING GRINDING	2
6	TOOL WEAR MESURMENT DURING MACHINING	2
7	MACHINING OF HARDENED STEELS BY VARYING PROCESS PARAMETERS IN EDM	2
8	DEMONSTRATION OF A SPINDLE GEAR BOX OF A CENTRE LATHE AND CONSTRUCTING THE RAY DIAGRAM FOR THE SAME	2
9	ALIGNMENT STUDY OF A CENTRE LATHE, STUDY OF MECHANISMS OF A CAPSTAN LATHE	4
10	Comprehensive Measurement, Dimensional and feature inspection by CMM, Inspection of threads using floating carriage micrometer Evaluation	6 2
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	PRODUCTION ENGINEERING LAB I
3.	**L-T-P structure**	0-0-2
4.	**Credits**	1
5.	**Course number**	MEP
6.	**Status** (*category* for *program*)	CORE FOR ME2

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	With Manufacturing lab I of ME1 (60%)
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	Prac part of MEL 234

9.	**Not allowed for** (indicate program names)	ME1
10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem
11.	**Faculty who will teach the course** S.Ghosh, D.Ravikumar, N.Bhatnagar and S.Aravindan	
12.	**Will the course require any visiting faculty?**	No
13.	**Course objective** *(about 50 words)*: The objective of the course is to give hands on exposure on primary manufacturing processes such as casting, forming and powder metallurgical processes and their applications.	
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)*: Experiemnts on casting, forming, injection molding and powder metallurgical processes.	

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		3
2		3
3		3
4		4
5		6
6		1
7		3
8		3
9		3
10		4
11		7
12		2
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Introduction to lab and safety	2
2	Moulding sand - size and morphology analysis: property testing	2
3	Study of investment casting process for precision castings Fluidity Estimation of cast iron at different pouring temperatures Study on die casting and centrifugal casting	2 2 2
4	a.Processing of polymers into product by Injection molding b.Process parameter control in Injection molding process	4
5	Thermoforming of polymer	2
6	Effect of cold rolling on hardness of Al alloy sheets	2
7	Drop forging of a spanner and study of power hammer	2
8	Determination of formability in deep drawing and stretch forming.	2
9	Determination of springback in bending of different materials.	2
10	Compaction, sintering and hot isostatic pressing of powder metallurgical samples	4
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Manufacturing Engineering and Technology – Kalpakjian (Addison Wesley)
2. Modern Manufacturing Processes - Groover
3. Principles of Metal Casting – RW Heine, CR Loper and PC Rosenthal (Tata-McGraw Hill).
4. Mechanical Metallurgy (Part IV) – G E Dieter (Tata-McGraw Hill).
5. Metal Forming: Processes and Analysis-B. Avitzur
6. Industrial Metal Working Processes- G.W. Rowe
7. Manufacturing Science – A. Ghosh and A.K. Mallik (East West Press).

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	Yes
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	Yes
19.5	Equipment	Yes
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	PRODUCTION ENGGLAB II
3.	**L-T-P structure**	0-0-2
4.	**Credits**	1
5.	**Course number**	MEP
6.	**Status** (*category* for *program*)	CORE

7.	**Pre-requisites** (course no./title)	PRODUCTION ENGG LAB I

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	ME1

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** Prof P V Rao, S. Ghosh,S. Jha, S Aravindan	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** The objective of the course is to give hands on exposure on machining and welding processes
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Experiments on machining and welding processes

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Introduction to Lab and safety related issues	2
2	Study of chip forms during turning under various process parametric conditions, Role of machining process parameters on surface finish	4
3	Temperature Measurement during turning process Tool wear measurement during machining	4
4	Effect of dressing parameters on surface finish during grinding.	2
5	Improving machining of difficult to machine materials	2
6	Machining of brittle materials using USM. Machining of hardened steel by varying process parameters in EDM.	4
7	Demonstration of a spindle gear box of a centre lathe and constructing the Ray diagram for the same.	2
8	Bead on plate studies in SMAW process: mild steel on mild steel plate, stainless steel on mild steel plate	2
9	Weld Bead analysis in GTAW process with and without filler	2
10	Effect of process parameters in GMAW process through microstructural analysis of weld bead Evaluation	2 2
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	

19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course*(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	IE LAB 1
3.	**L-T-P structure**	0-0-2
4.	**Credits**	1
5.	**Course number**	
6.	**Status** (*category* for *program*)	Core

7.	**Pre-requisites** (course no./title)	Operations Research; Stochastic Modeling and Simulation

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	
10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem
11.	**Faculty who will teach the course** N. B. Bolia, M. S. Kulkarni, Kiran Seth	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The objective of the course is to expose students to a large problem starting from formulation to solution. The exposure would include both deterministic optimization problem as well as stochastic modeling and simulation oriented problems.The theory would be covered earlier, and this course would serve the requirements of hands on sessions to use the theory studied and real life problems.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Deterministic optimization problem formulation, solution using CPLEX, sensitivity analysis; Conceptualization/Visualization of problem situation, formulation of simulation model, simulation runs and output analysis.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	NA	
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Introduction to the course (1 practical session)	2
2	Simple examples on CPLEX (1 practical sessions)	2
3	Problem Formulation (1 practical session)	2
4	Solution Using CPLEX (2 practical sessions)	4
5	Sensitivity Analysis (2 practical sessions)	4
6	Conceptualization/Visualization of problem (2 practical sessions)	4
7	Creation of Simulation Model using Anylogic/Arena (2 sessions)	4
8	Output Analysis (2 practical sessions)	4
9	Evaluation and Conclusion (1 session)	2
10		
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Discrete Event Simulation: Modeling, Programming and Analysis. Fishman, G. S. Springer-Verlag Inc, New York, 2001.

AnyLogic 6 in Three Days: A Quick Course in Simulation Modeling. Grigoryev, Ilya. AnyLogic Company, 2012.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	AnyLogic, CPLEX
19.2	Hardware	Computers depending on class size
19.3	Teaching aides (videos, etc.)	

19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	ME
2.	**Course Title** *(< 45 characters)*	IE LAB 2
3.	**L-T-P structure**	0-0-2
4.	**Credits**	1
5.	**Course number**	
6.	**Status** (*category* for *program*)	Core

7.	**Pre-requisites** (course no./title)	OR; Stochastic Modeling and Simulation; Mfg System Design

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	
10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** M. S. Kulkarni, N. Bolia	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The objective of the course is to expose students to the methodology of optimal design of Statistical Process Control (SPC) procedures as well as modeling and simulation of manufacturing systems.

The lab course will in two parts. The first part will cover SPC and the second part will cover discrete event simulation of manufacturing systems.

The experiments will be based on the topics covered in the Metrology and QA course as well as the Manufacturing System Design course.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

Design of optimal acceptance sampling plans, Design of optimal control charts

Simulation of process failures, Simulation of machine failures and Simulation of job shops and production lines with various production control mechanisms.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	NA	
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Economic design of acceptance sampling plans	4
2	Economi design of control charts	4
3	Learning Delmia shopfloor simulation software	8
4	Simulation of production lines with Kanban.	4
5	Simulation of production lines with CONWP	4
6	Evaluation	4
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Quest (Delmia V6) manuals 2013

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Quest (Delmia V6)
19.2	Hardware	Computers depending on class size
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Mechanical Engg
2.	**Course Title** *(< 45 characters)*	MAJOR PROJECT BTP-I
3.	**L-T-P structure**	0-0-6
4.	**Credits**	3
5.	**Course number**	-
6.	**Status** (*category* for *program*)	Core for ALL UG Students

7.	**Pre-requisites** (course no./title)	EC 120

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	No
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supercedes any existing course*	-

For 2011 and earlier entry students, this course be considered equivalent to the old MEL737 course.

9.	**Not allowed for** (indicate program names)	-

10.	**Frequency of offering**	☐ Every sem ☒ 1st sem ☐ 2nd sem ☐ Either sem

11.	**Faculty who will teach the course** All Mechanical faculty, All applied mechanics faculty	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)*:

The objective of the project is to impart an experience of working in a team on an engineering problem related to mechanical engineering that may include: formulation and definition of the problem, survey and self learning of the existing relevant literature, planning a methodology, execution of the necessary analysis/design/manufacturing activities to achieve the objectives, analysis and presentation of the results and documentation. It is desirable that the project is Industry oriented/a real life problem.

14. Course contents *(about 100 words) (Include laboratory/design activities)*:

A broad outline of the contents is as follows and a project may include some or all of these activities:

	Team formation for designing, manufacturing and operating a selected product, formulating project management procedures. Need identification, assessment of alternative designs, selection of design for development, defining design and performance specifications, and testing procedure. Detailed mechanical, thermal and manufacturing-related design of systems, assemblies, sub-assemblies and components culminating in engineering drawings and material specifications; preparing bill of materials and identification of standard components and bought-out parts. Using engineering drawings, the process sheets are developed based on available materials, machine tools and other fabrication facilities. Materials and standard components are procured and manufacturing is carried out. After inspection, parts are accepted. Assembly procedure is finalized and the machine is assembled. Acceptance tests are carried out vis-à-vis specifications. Professional quality documentation of all designs, data, drawings, and results, change history, overall assessment, etc. is mandatory, along with a final presentation.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
	NA; No Lectures	
	COURSE TOTAL *(14 times 'L')*	

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
	The project is allotted to a group of students (preferably in a team of four or more) who work on a topic that could be in the form of a research project, an industrial problem or a product development. The project is executed under faculty supervision.	
	The students are expected to interact with the supervisor/s periodically and work on the project to achieve the set objectives as per the time schedule of the activities that are planned at the beginning of the project.	
	They should maintain a separate log-book in which they must regularly enter	

	the project activities as and when performed with dates.	
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

NA

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Need of Items 19.1 to 19.7 depends on the individual projects.
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	----
19.6	Classroom infrastructure	----
19.7	Site visits	----

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	Design content depends on the individual projects.
20.2	Open-ended problems	--
20.3	Project-type activity	--
20.4	Open-ended laboratory work	--
20.5	Others (please specify)	--

Date: (Signature of the Head of the Department)