MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering

Scheme and Syllabus

2017-18 Admitted batch

Mechanical Engineering

upto VIII sem

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)

Department of Mechanical Engineering

Scheme of Examination: Bachelor of Technology (B.Tech.) Mechanical Engineering

GROUP B: I Semester (*For batches admitted in Session 2017-18*)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem.	Mid Sem.	Quiz/ Assignment	End Sem.	Lab Work & Sessional		L	T	P	
1.	**100101**	**BSC**	**Engineering Chemistry (BSC-1)**	70	20	10	30	20	150	4	1	2	6
2.	**100102**	**BSC**	**Engineering Mathematics-I (BSC-2)**	70	20	10	-	-	100	4	1	-	5
3.	**100103**	**HSMC**	**Technical English (HSMC-1)**	70	20	10	30	20	150	4	1	2	6
4.	**100104**	**ESC**	**Basic Electrical & Electronics Engineering (ESC-1)**	70	20	10	30	20	150	4	1	2	6
5.	**100105**	**ESC**	**Engineering Graphics (ESC-2)**	70	20	10	30	20	150	4	1	2	6
6.	**100106**	**ESC**	**Manufacturing Practices (ESC-3)**	-	-	-	30	20	50	-	-	2	1
			Total	**350**	**100**	**50**	**150**	**100**	**750**	**20**	**5**	**10**	**30**
Induction programme of first three weeks (MC):Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations													

GROUP A: (Electrical, Electronics, Computer Science, Information technology, Electronics & telecommunication)

GROUP B: (Civil, Mechanical, Chemical, Biotech, Automobile)

01Theory Period=1 Credit; 02 Practical Periods =1 Credit

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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Department of Mechanical Engineering

Scheme of Examination: Bachelor of Technology (B.Tech.) Mechanical Engineering

GROUP B: II Semester (*For batches admitted in Session 2017-18*)

S.No	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem.	Mid Sem.	Quiz/ Assignment	End Sem.	Lab work& Sessional		L	T	P	
1.	**100201**	**BSC**	**Engineering Physics (BSC-3)**	70	20	10	30	20	150	4	1	2	6
2.	**100202**	**HSMC**	**Energy, Environment, Ecology & Society (HSMC-2)**	70	20	10	-	-	100	4	1	-	5
3.	**100203**	**ESC**	**Basic Computer Engineering (ESC-4)**	70	20	10	30	20	150	4	1	2	6
4.	**100204**	**ESC**	**Basic Mechanical Engineering (ESC-5)**	70	20	10	30	20	150	4	1	2	6
5.	**100205**	**ESC**	**Basic Civil Engineering & Mechanics (ESC-6)**	70	20	10	30	20	150	4	1	2	6
6.	**100206**	**HSMC**	**Language Lab. & Seminars (HSMC-3)**	-	-	-	30	20	50	-	-	2	1
			Total	**350**	**100**	**50**	**150**	**100**	**750**	**20**	**5**	**10**	**30**
Summer Internship Project –I (Institute Level) (Qualifier): Minimum two-week duration													

GROUP A: (Electrical, Electronics, Computer Science, Information technology, Electronics & telecommunication)

GROUP B: (Civil, Mechanical, Chemical, Biotech, Automobile)

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MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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Department of Mechanical Engineering

Scheme of Examination: Bachelor of Technology (B.Tech.) Mechanical Engineering

III Semester (*For batches admitted in Session 2017-18)*

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Lab Work & Sessional		L	T	P	
1.	**100001**	**BSC**	**Engineering Mathematics-II (BSC-4)**	70	20	10	-	-	100	3	1	-	4
2.	**120301**	**ESC**	**Material Science (ESC-7)**	70	20	10	-	-	100	3	1	-	4
3.	**120302**	**DC**	**Mechanics of Materials (DC-1)**	70	20	10	30	20	150	3	-	2	4
4.	**120303**	**DC**	**Theory of Machines –I (DC-2)**	70	20	10	30	20	150	3	-	2	4
5.	**120304**	**DC**	**Fluid Mechanics and Hydraulic Machines (DC-3)**	70	20	10	30	20	150	3	-	2	4
6.	**120305***	**DLC**	**Software Lab (DLC-1)**	-	-	-	30	20	50	-	-	2	1
7.	**120306#**	**SEMINAR/ SELF STUDY**	**Self-learning/Presentation (SWAYAM/NPTEL/MOOC)**	-	-	-	-	25	25	-	-	2	1
8.	**120307**	**DLC**	**Summer Internship Project-I (Institute Level) (Evaluation)**	-	-	-	25	-	25			4	2
			Total	**350**	**100**	**50**	**145**	**105**	**750**	**15**	**2**	**14**	**24**
NSS/NCC				**Qualifier**									

***Virtual Lab to be conducted along with the traditional lab**

 # Compulsory registration for one online course using SWAYAM/NPTEL/ MOOC, evaluation through attendance, assignments and presentation.

GROUP B: (Civil, Mechanical, Chemical, Biotech, Automobile)

01Theory Period=1 Credit; 02 Practical Periods =1 Credit

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Department of Mechanical Engineering

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IV Semester (*For batches admitted in Session 2017-18)*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work & Sessional		L	T	P	
1.	**100003**	**BSC**	**Mathematics- III (BSC-5)**	70	20	10	-	-	100	3	1	-	4
2.	**120401**	**DC**	**Theory of Machines –II (DC-4)**	70	20	10	30	20	150	2	1	2	4
3.	**120402**	**DC**	**Design of Machine Elements (DC-5)**	70	20	10	30	20	150	2	1	2	4
4.	**120403**	**DC**	**Manufacturing Process (DC-6)**	70	20	10	-	-	100	3	1	-	4
5.	**120404**	**DC**	**Engineering Thermodynamics (DC-7)**	70	20	10	-	-	100	3	1	-	4
6.	**100004**	**MC**	**Cyber Security (MC)**	70	20	10	-	-	100	2	1	-	3
7.	**120405***	**DLC**	**Production Lab (DLC-2)**	-	-	-	30	20	50	-	-	4	2
			Total	**420**	**120**	**60**	**90**	**60**	**750**	**15**	**6**	**8**	**25**
8.	**100002 $**	**MC**	**Biology for Engineers (Audit Course)(MC)**	70	20	10	-	-	100	3	-	-	-
NSS/NCC				**Qualifier**									
Summer Internship Project-II (Soft skills Based) for two weeks duration: Evaluation in V Semester													

***Virtual Lab to be conducted along with the traditional lab**

$Course will run for Group A/B in III/IV semester respectively. Passing is optional; however a separate mark sheet will be issued to those who qualify.

GROUP B: (Civil, Mechanical, Chemical, Biotech, Automobile), 01Theory Period=1 Credit; 02 Practical Periods =1 Credit

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V Semester (*For batches admitted in Session 2017-18)*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact hours per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem.	Mid Sem Exam.	Quiz/ Assignment	End Sem.	Lab work & Sessional		L	T	P	
1.	**120501**	**DC**	**Industrial Engineering (DC-8)**	70	20	10	-	-	100	3	-	-	3
2.	**120502**	**DC**	**Metal Cutting and Machine Tools (DC-9)**	70	20	10	-	-	100	2	1	-	3
3.	**120503**	**DC**	**Heat And Mass Transfer(DC-10)**	70	20	10	30	20	150	2	-	2	3
4.	**120504**	**DC**	**Thermal Engineering (DC-11)**	70	20	10	30	20	150	2	-	2	3
5.	**120505**	**DC**	**Machine Design (DC-12)**	70	20	10	30	20	150	2	-	2	3
6.	**120506****	**DLC**	**Minor Project-I (DLC-3)**	-	-	-	30	20	50	-	-	2	1
7.	**120507**	**DLC**	**Summer Internship Project-II (Evaluation) (DLC-4)**	-	-	-	25	-	25	-	-	4	2
8.	**120508#**	**SEMINAR/ SELF STUDY**	**Self-learning/Presentation (SWAYAM/NPTEL/ MOOC)**	-	-	-	-	25	25	-	-	2	1
			Total	**350**	**100**	**50**	**145**	**105**	**750**	**11**	**1**	**14**	**19**
Department level activity/workshop/awareness programme to be conducted; certificate of compliance to be submitted by HoD to the Exam Controller through Dean Academics													
Additional Courses for obtaining Honours or minor Specialization by desirous students	**Permitted to opt for maximum two additional courses for the award of (i) Honours in parent discipline or (ii) Minor Specialization in engineering discipline other than the parent discipline**												

**** The minor project-I may be evaluated by an internal committee for awarding Sessional marks.**

 # Compulsory registration for one online course using SWAYAM/NPTEL/ MOOC, evaluation through attendance, assignments and presentation

GROUP B: (Civil, Mechanical, Chemical, Biotech, Automobile)01Theory Period=1 Credit; 02 Practical Periods =1 Credit

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Scheme of Examination: Bachelor of Technology (B.Tech.) Mechanical Engineering

VI Semester (*For batches admitted in Session 2017-18*)

S. No	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot		MOOCs						
				End Sem.	Mid Sem	Quiz/ Assignment	End Sem.	Lab work & Sessional	Assign ment	Exam		L	T	P	
1.	**100005***	**HSM**	**Ethics, Economics, Entrepreneurship & Management (HSMC-4)**	70	20	10	-	-	-	-	100	2	-	-	2
2.	**120601**	**DC**	**Advance Production Technology (DC-13)**	70	20	10	30	20	-	-	150	2	-	2	3
3.	**DE**	**DE**	**Departmental Elective-1(DE-1)**	70	20	10	-	-	-	-	100	2	-	-	2
4.	**DE[#]**	**DE**	**Departmental Elective-2(DE-2)**	-	-	-	-	-	25	75	100	2	-	-	2
5.	**OC**	**OC**	**Open Category (OC-1)**	70	20	10	-	-	-	-	100	2	-	-	2
6.	**100007**	**MC**	**Disaster Management (MC)**	70	20	10	-	-	-	-	100	2	-	-	2
7.	**120605**	**DLC**	**Minor Project-II (DLC-5)**	-	-	-	50	50	-	-	100	-	-	4	2
			Total	**350**	**100**	**50**	**80**	**70**	**25**	**75**	**750**	**12**	**-**	**6**	**15**
8.	**100006[$]**	**MC**	**Indian Constitution & Traditional Knowledge (Audit Course) (MC)**	70	20	10	-	-	-	-	100	3	-	-	-
				Summer Internship-III (On Job Training) for Four weeks duration: Evaluation in VII Semester											
Additional Courses for obtaining Honours or minor Specialization by desirous students				**Permitted to opt for maximum two additional courses for the award of (i) Honours in parent discipline or (ii) Minor Specialization in engineering discipline other than the parent discipline**											

DE-1 (Through Traditional Mode)			DE-2[#]			Open Category (OC-1)		
S.No.	**Subject Code**	**Subject Name**	**S.No.**	**Subject Code**	**Subject Name**	**S.No.**	**Subject Code**	**Subject Name**
1	120611	Vibration and Noise Engineering	1	120651	Power Plant Engineering	1	900101	Robotics
2	120612	Statistical Quality Control	2	120652	Fundamental of Welding Science and Technology	2	900102	Product Design
3	120613	Work Study and Ergonomics	3	120653	Gear and Gear unit Design: Theory and Practice			
4	120614	Turbo Machinery						

[*]Group A/B programmes will offer this course in V/VI Semester respectively.

[#]This courses will run through SWAYAM/NPTEL/ MOOC

[$]Group A/B programmes will offer this course in V/VI Semester respectively. Passing is optional; however a separate mark sheet will be issued to those who qualify.

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VII Semester ***For batches admitted in Session 2017-18***

S.No.	Subject Code	Category	Subject Name & Title	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot		MOOCs						
				End Sem.	Mid Sem.	Quiz/ Assignment	End Sem.	Lab Work & Sessional	Assignment	Exam		L	T	P	
1.	**DE**	**DE**	**Departmental Elective-3 (DE-3)**	70	20	10	-	-	-	-	100	2	-	-	2
2.	**DE***	**DE**	**Departmental Elective -4 (DE-4)**	-	-	-	-	-	25	75	100	2	-	-	2
3.	**OC**	**OC**	**Open Category-2(OC-2)**	70	20	10	-	-	-	-	100	2	1	-	3
4.	**OC**	**OC**	**Open Category -3(OC-3)**	70	20	10	-	-	-	-	100	3	-	-	3
5.	**100008**	**MC**	**Intellectual Property Rights (IPR) (MC)**	70	20	10	-	-	-	-	100	2	-	-	2
6.	**120701**	**DLC**	**Reliability and Vibration Lab (DLC-6)**	-	-	-	50	50	-	-	100	-	-	4	2
7.	**120702**	**DLC**	**Summer Internship Project-III (04 weeks Evaluation) (DLC-7)**	-	-	-	50	50	-	-	100	-	-	4	2
8.	**120703**	**DLC**	**Creative Problem Solving (Evaluation) (DLC-8)**	-	-	-	25	25	-	-	50	-	-	2	1
			Total	**280**	**80**	**40**	**125**	**125**	**25**	**75**	**750**	**11**	**1**	**10**	**17**
Additional Courses for obtaining Honours or minor Specialization by desirous students				**Permitted to opt for maximum two additional courses for the award of (i) Honours in parent discipline or (ii) Minor Specialization in engineering discipline other than the parent discipline**											

DE-3 (Through Traditional Mode)			DE-4*			Open Category (OC-2)			Open Category (OC-3)		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	120711	Refrigeration and Air-Conditioning	1	120751	Foundation of Computational Fluid Dynamics	1	900203	Industrial Automation	1	900214	Engineering Materials for Industrial Applications
2	120712	Basic of Finite Element Analysis	2	120752	Introduction to Composites	2	900204	Solar Energy	2	900215	Maintenance Engineering
3	120713	Metrology, Measurement and Control	3	120753	Advanced Machining Processes						
4	120714	Total Quality Management	4	120754	Industrial Safety Engineering						

***This course must be run through SWAYAM/NPTEL/ MOOC**

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VIII Semester *For batches admitted in Session 2017-18*

S.No.	Subject Code	Category	Subject Name & Title	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot		MOOCs						
				End Sem.	Mid Sem.	Quiz/ Assignment	End Sem.	Lab Work & Sessional	Assign ment	Exam		L	T	P	
1.	DE*	DE	Departmental Elective – 5*(DE-5)	-	-	-	-	-	25	75	100	2	-	-	2
2.	OC*	OC	Open Category– 4* (OC-4)	-	-	-	-	-	25	75	100	2	-	-	2
3.	OC*	OC	Open Category – 5* (OC-5)	-	-	-	-	-	25	75	100	2	-	-	2
4.	120801	DLC	Internship/Project (DLC-9)	-	-	-	250	150	-	-	400	-	-	6	3
5.	120802#	PD	Professional Development	-	-	-	-	50	-	-	50	-	-	2	1
			Total	**-**	**-**	**-**	**250**	**200**	**75**	**225**	**750**	**6**	**-**	**8**	**10**
Additional Courses for obtaining Honours or minor Specialization by desirous students			**Permitted to opt for maximum two additional courses for the award of (i) Honours in parent discipline or (ii) Minor Specialization in engineering discipline other than the parent discipline**												

DE-5*			Open Category (OC-4)*			Open Category (OC-5)*		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	120851	Quality Design and Control	1	900605	Waste to Energy Conversion	1	900611	Mechatronics
2	120852	Robotics: Basics and Selected Advanced Concepts	2	900609	Product Design and Manufacturing	2	900612	Elements of Solar Energy Conversion
3	120853	Steam and Gas Power Systems	3	900610	Automatic Control	3	900613	Traditional and Non-Traditional Optimization Tools

***All of these courses will run through SWAYAM/NPTEL/ MOOC**

#Evaluation will be based on participation/laurels brought by the students to the institution in national/state level technical and other events during the complete tenure of the UG program(participation in professional chapter activities, club activities, cultural events, sports, personality development activities, collaborative events, MOOCs and technical events)

GROUP B: (Civil, Mechanical, Chemical, Biotech, Automobile)

01Theory Period=1 Credit; 02 Practical Periods =1 Credit

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Department of Mechanical Engineering

For batch admitted in Academic Session 2017-18

100105: Engineering Graphics

Category	Title	Code	Credit-6			Theory Slot
			L	T	P	
Engineering Science-ESC	Engineering Graphics	100105/CEL/MEL/CSL/ EEL/ELL/ITL/CHL/ BTL105/1X25/BEEL/BELL/ BETL/BCHL/BAUL105/ BCEL/BMEL/BCSL/ BITL/BBTL204	4	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objective:

1. To inculcate the imagination and mental visualization capabilities for interpreting the geometrical details of common engineering objects.
2. To impart knowledge about principles/methods related to projections of one,two and three dimensional objects.

Syllabus:

Unit - 1

Introduction and scale: Basics of instruments, Lettering and dimensioning, Plane geometrical constructions. Plain and diagonal scale - Representative fraction, Unit conversion and Exercises based on linear, area, volume and speed. Scale of chord.

Engineering curves: Cycloidal curves - cycloid, epicycloid and hypocycloid curve, tangent and normal. Spiral curves - Archimedean and logarithmic spiral curves. Tangent & normal on the curves. Involute curve.

Unit - 2

Projection of points: Introduction, types of projections, quadrant system, positions of points and Exercise.

Projection of straight line: Introduction, Orientation of a straight line, Traces of a line and Exercise.

Unit - 3

Projection of planes: Introduction, Types of planes, Traces of planes, Position of planes and Exercise.

Projection of solids: Introduction, Types of solids, Positions of solids and Exercise.

Unit - 4

Section of solids: introduction, Types of section planes and Anti-section and Exercise.

Development of surfaces of right solids: Introduction, Methods of development & anti-development and Exercise.

Intersection of cylinders: Introduction, methods of developments, intersection of cylinder by another cylinder and exercise.

Unit - 5

Isometric projections: Introduction, isometric scale, isometric axis, isometric view and isometric projections from orthographic views, orthographic views from pictorial view and exercise.

Computer Aided Drafting using Auto CAD: Introduction, software's basic commands, transformation and editing commands.

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Course Outcomes: After successful completion of this course students will be able to:

CO1. **Visualize** the geometric details of engineering objects.
CO2. **Translate** the geometric information of engineering objects into engineering drawings.
CO3. **Draw** orthographic projections and sections.
CO4. **Develop** knowledge to read, understand and explain drawing.
CO5. **Improve** their skills so that they can apply these skills in developing new products.
CO6. **Prepare** simple layout of factory, machine and buildings.

Text books:

1. Engineering Drawing by N. D. Bhatt, Charotar Publication Pvt. Ltd.
2. Engineering Drawing by P.S. Gill, S. K. kataria& sons, Delhi
3. Engineering Drawing by BasantAgrawal& C. M. Agrawal, Tata McGraw Hill Education Pvt. Ltd.
4. Engineering Graphics by K. Venugopal, New Age International Publication, India

NPTEL Link for Engineering Graphics:

http://nptel.ac.in/courses/112103019/

Laboratory Work

List of Experiments:

1. To prepare sheet of Plain scale, diagonal scale and Scale of chord.
2. To prepare sheet of Cycloidal curves.
3. To prepare sheet of Projection of points and lines.
4. To prepare sheet of Projection of Planes.
5. To prepare sheet of Projection of Solids.
6. To prepare sheet of Section of Solids.
7. To prepare sheet of Development of Surfaces.
8. To prepare sheet of Isometric and Intersection of Solids.

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100106: Manufacturing Practices

Category	Title	Code	Credit-1			Practical Slot
			L	T	P	
Engineering Science-ESC	Manufacturing Practices	100106	-	-	2	Max.Marks-50 Min.Marks-16.

Course Objectives:

1. To familiarize with the basics of tools and equipments used in fitting, carpentry, sheet metal, welding and smithy.
2. To with the production of simple models in the above trades.
3. To develop general machining skills in the students.

Syllabus

UNIT-I

Introduction: Manufacturing Processes and its Classification, Casting, Machining, Plastic deformation and Metal forming, Joining Processes, Heat treatment process, Assembly process.

Black Smithy Shop

Use of various smithy tools. Forging operations; Upsetting, Drawing down, Fullering, swaging, Cutting down, Forge welding, Punching and drafting.

Suggested Jobs: Forging of chisel, forging of Screw Driver.

UNIT-II Carpentry Shop

Timber: Type, Qualities of timber disease, Timber grains, Structure of timber, Timber seasoning, Timber preservation. Wood Working Tools: Wood Working Machinery, joints and joinery, various operations of planning using various carpentry planes sawing & marking of various carpentry joints.

Suggested Jobs: Name Plate, Any of the carpentry joint like mortise or tennon Joint.

UNIT-III Fitting Shop:

Study and use of measuring instruments, Engineer steel rule, Surface gauges caliper, Height gauges, feeler gauges, Micrometer. Different types of files, File cuts, File grades, Use of surface plate, Surface gauges drilling tapping Fitting Operations: Chipping filling, Drilling and Tapping.

Suggested Jobs: Preparation of job piece by making use of filing, sawing and chipping, drilling and tapping operation.

UNIT-IV Foundry:

Pattern Making: Study of pattern materials, pattern allowances and types of patterns. Core box and core print, Use and care of tool used for making wooden patterns.

Moulding: Properties of good mould& Core sand, Composition of Green, Dry and Loam sand. Methods used to prepare simple green and bench and pit mould dry sand bench mould using single piece and split patterns.

UNIT-V Welding: Study and use of tools used for Brazing, Soldering, Gas& Arc welding. Preparing Lap & Butt joints using Gas and Arc welding methods, study of TIG and MIG welding processes.Safety precautions.

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Course Outcome: After successful completion of this course students will be able to:

CO1. **Discuss** the hand tools, machine tools and power tools.

CO2. **Utilize** appropriate tools required for specific operation.

CO3. **Apply** safety measures required to be taken while using the tools in floor shops, Machine ships and carpentry shop.

CO4. **Use** the techniques, skills, and modern engineering tools necessary for manufacturing and production engineering.

CO5. **Conduct** experiments in the field of Production engineering.

CO6. **Design** a system, components, or process to meet desired needs, ethical, health and safety, manufacturability and sustainability.

Text & References Books:

1. Bawa HS; Workshop Practice, TMH
2. Rao PN; Manufacturing Technology-Vol.1 & 2, TMH
3. John KC; Mechanical Workshop Practice; PHI
4. HazraChoudhry; workshop Practice-Vol.1 & 2.
5. Jain R. K.; Production Technology

NPTEL Link for Manufacturing Practices

http://nptel.ac.in/courses/112107145/

Laboratory Work:

Relevant shop floor exercises involving practice in forging, Carpentry, fitting, pattern making, Sand casting, Moulding, Welding, Sheet metal fabrication techniques.

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Department of Mechanical Engineering

For batch admitted in Academic Session 2017-18

100204 – Basic Mechanical Engineering

Category	Title	Code	Credit-6			Theory Paper
			L	T	P	
Engineering Science-ESC	Basic Mechanical Engineering	100204/CEL/MEL/ CSL/EEL/ ELL/ITL/CHL/ BTL114/2X24	4	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students:

1. Develop the fundamentals of Engineering materials, measurement and reciprocating machines.
2. Develop an ability to understand the Thermodynamic laws, steam generator and reciprocating machines for solving engineering problems.
3. Demonstrate Engines and Boiler fundamentals using models.

Syllabus

UNIT-I:

Materials: Classification of engineering material, composition of cast iron and carbon steels on iron-carbon diagram and their mechanical properties; Alloy steel and their applications; Stress-Strain diagram, Hooks law and modulus of elasticity. Tensile, shear, hardness and fatigue testing of materials.

UNIT-II:

Measurement: Temperature, pressure, velocity, flow, strain, force and torque measurement, concept of measurement error & uncertainty analysis, measurement by Vernier caliper, micrometer, dial gauges, slip gauges, sine-bar and combination set; introduction to lathe drilling, milling and shaping machines.

UNIT-III

Fluids: Fluid properties, pressure, density and viscosity; pressure variation with depth, static and kinetic energy; Bernoulli's equation for incompressible fluids, viscous and turbulent flow, working principle of fluid coupling, pumps, compressors, turbines, positive displacement machines and pneumatic machines. Hydraulic power & pumped storage plants for peak load management as compared to base load plants.

UNIT-IV

Thermodynamics: Zeroth, First, second and third law of thermodynamics; steam properties, steam processes at constant pressure, volume, enthalpy & entropy, classification and working of boilers, efficiency & performance analysis, natural and induced draught, calculation of chimney height. Refrigeration, vapour absorption and compression cycles, coefficient of performance (COP).

UNIT-V

Reciprocating Machines: Steam engines, hypothetical and actual indicator diagram; Carnot cycle and ideal efficiency; Otto and diesel cycles; working of two stroke & four stroke petrol and diesel IC engines.

Course Outcomes: After successful completion of this course students will be able to:

CO1. Define the essential concepts of thermal, design and production used in Mechanical Engineering.
CO2. Summarize fundamental techniques and process used in power generating machines
CO3. Solve the various problems based on basic concepts of Mechanical Engineering.
CO4. Analyze the various gas, steam and air cycles.
CO5. Evaluate the problems of Steam Generator, Thermodynamics, Steam and I.C. engines

CO6. Generate the skills to demonstrate steam Generator and reciprocating machine in depth.

Reference Books:

1. Narula; Material Science; TMH
2. Agrawal B & CM; Basic Mechanical Engineering; TMH
3. Nag PK, Tripathi et al; Basic Mechanical Engineering; TMH
4. Rajput; Basic Mechanical Engineering;
5. Sawhney GS; Fundamentals of Mechanical Engibneering; PHI
6. Nakra and Chaudhary; Instrumentation and Measurement; TMH
7. Nag PK; Engineering Thermodynamics; TMH
8. Ganesan; Combustion Engines; TMH

Lists of Experiments:

1. Study of simple vertical boilers.
2. Study of Locomotive boilers.
3. Study of Babcock and Wilcox boilers.
4. Study of Lancashire, Cornish and Cochran boilers.
5. Study of boiler mounting and accessories.
6. Study of 2 stroke diesel and petrol engines.
7. Study of 4 stroke diesel and petrol engines.
8. Study of simple steam engines.
9. Study of Lathe machine.
10. Study of Vernier and Micrometer.
11. Study of Internal Combustion Engine Parts.

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Material Science

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Engineering Science Course-ESC	Material Science	120301/190301/ BMEL305/ BAUL301/ MEL-302/3223	3	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. The basic fundamentals of materials science and engineering.
2. The different classes of materials, their properties, structures and imperfections present in them.
3. The functional properties of materials and the roles of microstructure, heat treatment defects and environment play in typical engineering applications.

Syllabus

Unit-I Structure and Properties of Materials

Concept of crystalline and non-crystalline materials, Crystal structures analysis and Crystal system, Homogeneous and heterogeneous solidifications, Crystal imperfections. Miller indices and directions, Properties and uses of engineering materials. Stress-strain diagram for steels.

Unit-II Engineering Materials

Ferrous and non-ferrous metals and alloys, Nano-materials, Ceramic material, Composite material with their properties, uses and coding.

Unit-III Deformation of Materials

Types of deformations, Mechanism of deformations, Role of dislocations, Slip and twinning processes. Stages of deformation, Mechanism of ductile and brittle fracture.

Unit-IV Phase Diagrams

Concept of phases, Solidification of metals and alloys, Allotropy of iron, Fe-C diagram, Lever-rule, Eutectic, Eutectoid, Peritectic and Peritectoid systems.

Unit-V Heat Treatment of Steels

Micro constituents of steel, Importance of heat treatment processes, “S-curve and C-curve”, Heat treatment processes and surface treatment processes.

Course Outcomes: After successful completion of this course students will be able to:

CO1. State the principles of diffusion theory and various types of defects in materials.

CO2. Discuss mechanical properties of materials

CO3. Compare the different processes to alter the material properties.

CO4. Determine the effect of different phases, impurities on the behavior of materials.

CO5. Analyze crystal structure and composition of different materials.

CO6. Create the different engineering materials and alloys.

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Text & Reference Books

1. Elements of Material Science and Engineering **by** Lawrence, H. Vanvlackdison; Wesley.Mention the Year or the Edition and Publisher and Place of Publication
2. Material Science and Engineering **by** Raghvan, V; Prentice Hall of India.
3. Introduction to Engineering Materials **by** Agrawal, B.K; Tata McGraw Hill, N. Delhi.

NPTEL Link for Material Science

https://onlinecourses.nptel.ac.in/noc18_mm05/preview

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Mechanics of Materials/ Mechanics of Materials-I

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Mechanics of Materials	120302/ 190302/ BMEL-302/ MEL-305/ 3225	3	-	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Pre-Requisites:

Basic Civil Engineering and Mechanics (Subject Code – 100205)

Course Objectives: To make the students:

1. Learn the basic concepts and principles of strength of materials.
2. Calculate stresses and deformations of objects under external loadings.
3. Apply the knowledge of strength of materials on engineering applications and design problems.

Syllabus

Unit- I Stress and strain: Stress-strain relationship and elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain, compound and combined stresses, thermal stresses.

Unit-II Stresses in beams: Shear Force & Bending Moment diagram, theory of simple bending, Section Modulus, bending Stresses and Shear stresses in beam.

Slope and deflection: Equation of Elastic Curve, Macaulay's Method, Area Moment Method, Strain Energy Methods etc.

Unit- III Shear stress distribution: Horizontal, Vertical, Transverse, Longitudinal Shear Stress, Graphical Methods for Different Sections.

Shafts: Torsion of circular shaft, stress concentration in shafts; series and parallel combination.

Unit -IV Column and Struts: Euler's theory of column, Rankine's formula, slenderness ratio; strut with eccentric load.

Thin cylinder: Stress and Strain in thin cylinder, wire wound thin cylinder; thin spherical shells.

Unit- V Materials testing: Tensile, compressive, hardness, impact and torsion testing. Strain Gauges - types of strain gauges, electrical strain gauges, Gauge factor, strain rosette.

Strain Energy: Strain energy due to direct stress, simple shear, torsion, bending, shear force in beams.

Course Outcomes: After successful completion of this course students will be able to:

CO-1 **Identify** various structural elements and its application.

CO-2 **Illustrate** different types of stress and strain on various types of structural elements like beam, shaft column etc.

CO-3 **Calculate** principal stresses, maximum shearing stress, and the different stresses acting on a structural member.

CO-4 **Analyze** stresses and deflection for beam, shaft, long columns, thin cylinder etc.

CO-5 **Select** appropriate materials in design considering engineering properties, sustainability, cost and weight.

CO-6 **Design** simple bars, beams, and circular shafts to meet desired needs in terms of strength and deformation.

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Text & Reference Books

1. Strength of Materials (MoM) **by** R S Lehri and A S Lehri; S K Katariya and Sons Pub.
2. Strength of Materials **by** S S Rattan; McGraw Hill Pub.
3. Mechanics of Materials **by** F P Beer, E R Johnston, J T DeWolf; TATA McGraw Hill Pub.
4. Strength of Materials **by** S. Timoshenko; D Van NostrandCompnay,
5. Mechanics of Solids **by** Mubeen; Pearson Education Pub
6. Strength of Materials **by** S Ramamrurtham, R Narayan; DhanpatRai sons Pub.
7. Strength of Materials **by** Sadhu Singh; Khanna Publisher Pub.
8. Mechanics of Materials **by**AdarashSwaroop, New Age international Pub.

NPTEL Link for Mechanics of Material

https://onlinecourses.nptel.ac.in/noc18_ce04/preview

LIST OF EXPERIMENTS

1. Tension test
2. Compression Test
3. Bending Test.
4. Single / Double Shear Test
5. Fatigue Test
6. Hardness test on metals - Brinell and Rockwell Hardness Number. Rockwell hardness Test
7. Impact test on metal specimen.
8. Spring Testing
9. To draw Bending moment diagram for simply supported Beam under point Loads.

Lab Course Outcomes: After successful completion of this course lab students will be able to:

CO1. **Evaluate** the values of yield stress, breaking stress and ultimate stress of the given specimen under tension test.

CO2. **Conduct** the torsion test to determine the modulus of rigidity of given specimen.

CO3. **Perform** compression tests on spring and wood.

CO4. **Justify** the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.

CO5. **Determine** elastic constants using flexural and torsion tests.

CO6. **Examine** the stiffness of the open coil and closed coil spring and grade them.

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120303: Theory of Machines-I

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Theory of Machines-I	120303	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	2	

Course Pre-Requisite:
Engineering Graphics (Subject Code – 100105)
Mechanics of Materials (Subject Code – 120302)

Course objectives: To make the students:
1. Familiarize with different types of mechanisms.
2. Understand the basics of synthesis of simple mechanisms.
3. Apply fundamental of mechanics to machines which include engines, linkages etc.

Syllabus

Unit-I Mechanism: Machine, Mechanism, Kinematics Links, Pairs, Chains, Degree of freedom. Mechanisms and its Inversions; Slider, Double Slider and 4 bar mechanism. Lower pair mechanisms: pantograph, Straight line motions. Davis and Ackerman Steering Mechanisms.

Unit-II Kinematic Analysis: Displacement, velocity and acceleration analysis of plane mechanisms; relative velocity, instantaneous centre, Kennedy's Theorem, Klein's construction methods. Coriolis component.

Unit-III Dynamic Analysis: D'Alembert's principle. Equivalent dynamic system, Graphical and analytical methods of dynamic forces, analysis of mechanisms and machines including reciprocating engines.
Flywheel: Introduction, Turning-moment diagrams and Flywheel analysis.

Unit-IV Brakes: Analysis of simple brake assuming uniform pressures and uniform wear, band brake, block brakes, internal and external shoe brakes, braking of vehicles.
Clutches: Single plate and multi plate clutches, cone clutches, centrifugal clutches.
Dynamometers: Different types and their applications.

Unit-V Governors: Introduction, Types of governors, Various gravity and spring controlled governors, governor characteristics, Effort and power of a governor, Controlling force diagrams, Coefficient of insensitiveness.

Gyroscopes: Gyroscopic couple, Effect of Gyroscopic couple on the stability of four wheel and two wheel vehicles, Aeroplanes and Naval ships, Gyrostabilisers.

Course Outcomes: After successful completion of this course students will be able to:

CO 1. **Identify** basic mechanisms in real life applications.
CO 2. **Discuss** about mechanics of various machines.
CO 3. **Apply** fundamental principles of statics and dynamics to machinery.
CO 4. **Analyze** various types of motions and mechanisms of machinery.
CO 5. **Compare** various components suitable for different applications.e.g. different types of governor, clutch, brakes, flywheel etc.

CO 6. **Create** the mechanism or components to justify the demands of work.

Text &Reference Books:

1. Theory of Machines by Rattan, SS; TMH full detail of publicaiton
2. Theory of Machine by Norton, RL; TMH
3. Theory of Machine byBallaney, PL;Kanna Pub.
4. Mechanism and Machine Theory by Ambekar, AG; PHI.
5. Theory of Mechanism and Machines by Sharma, CS and Purohit K; PHI.
6. Theory of Machines by Bevan, Thomos; Pearson/ CBS PUB Delhi.
7. Mechanism and Machine Theory byRao, JS and Dukkipati; NewAge Delhi.
8. Theory of Machines byLal,Jagdish; Metropolitan Book Co; Delhi –
9. Theory of Mechanisms & Machines byGhosh,A.,Mallik,AK; Affiliated East West Press,Delhi.

NPTEL Link for Theory of Machines-I

http://nptel.ac.in/courses/112104121/1 and http://nptel.ac.in/courses/112104114/

List of experiments (expandable)

1. Study of Kinematics links pairs and chains.
2. To find degree of freedom of a given mechanism.
3. To study all inversions of four-bar mechanisms using models.
4. Draw velocity and acceleration polygons of all moving link joints in slider crank mechanism.
5. Study of inertia forces in reciprocating parts and analysis of flywheel.
6. Study of various types of governors.
7. Study of various types of clutch.
8. Study of various types of brakes.
9. Study of various types of dynamometer.
10. Use virtual lab for any two experiments.

Lab Course Outcomes: After successful completion of this course lab students will be able to:

CO1. **Design** and **analyze** mechanism required for the specified type of motion.
CO2. **Draw** inversions and determine velocity and acceleration of different mechanisms.
CO3. **Construct** different types of cam profile for a given data.
CO4. **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive.
CO5. **Compare** the various components related to machines and mechanism.
CO6. **Determine** the degrees-of-freedom (mobility) of a mechanism.

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120304: Fluid Mechanics and Hydraulic Machines

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Fluid Mechanics and Hydraulic Machines	120304/190304	3	-	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students understand:

1. Fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. And give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
3. And develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

Course Pre-Requisite:

Basic Mechanical Engineering. (Subject Code – 100204)

Syllabus

Unit-I **Properties of fluid:** Pressure, density, specific weight, viscosity, dynamic and kinematic viscosity Newton's law of viscosity and its applications.

Fluid Static: Pressure variation with depth, pressure measurement, pressure on immersed surface centre pressure, Buoyancy, flotation, stability of floating bodies.

Unit-II **Fluid Kinetics:** One dimensional flow approximation, control volumes concept, continuity equation in 3-D, its differential and integral form, velocity and acceleration of fluid particle, stream line, path line. Rotation, vorticity and circulation. Stream function and velocity potential function. Flow net, Free and forced vortex flow.

Unit-III **Fluid Dynamics:** Momentum theorem, Impulse momentum equation and its application, Euler's equation in 3-D, Bernoulli's equation for incompressible fluid flow, engineering applications of energy equation, Pitot -Tube, Venturi meter, Orifice meter.

Unit-IV **Flow through Pipes:** Critical Reynolds's number, velocity distribution in pipes, friction factor. Moody's chart, Laminar flow through pipe, Hagen-Poiseulli's equation, Turbulent flow through pipe, Hydraulic gradient line and total energy line. Minor head losses in pipes, Pipe Networking and Transmission of power through pipes.

Unit-V **Water Turbine:** Impulse and Reaction principles, Pelton, Francis and Kaplan turbines, velocity diagrams, Work done by turbines, Draft Tube theory.

Course Outcomes: After successful completion of this course students will be able to:

CO1: **Define** the fundamental properties of fluids.

CO2: **Relate** the concepts of mechanics with various laws of fluid mechanics.

CO3: **Identify** the laws of fluid mechanics applicable for the body in various fluids under different conditions.

CO4: **Analyse** various forces and their effects, related to fluids mechanics.

CO5: **Measure** and compare losses in different fluid flow conditions.

CO6: **Compare** different turbo machines depending on their behaviour and their merits and demerits

Text &Reference Books:

1. Fluid Mechanics by Streeter &Wylis; McGraw-Hills Pub.
2. Fluid Mechanics by Modi& Seth; Standard publishing house.
3. Fluid Mechanics by D.S. Kumar ;Katson publisher.
4. Fluid Mechanics by R.K. Bansal; Laxmi Publishing House.
5. Fluid Mechanics byYunus A Cengel& John M. Cimbala; Tata McGraw Hill Edition.

NPTEL Link for Fluid Mechanics and Hydraulic Machines

http://nptel.ac.in/courses/112105171/1

List of Experiments:

1. Calculate the coefficient of discharge of Venturimeter.
2. Calculate the Cd, Cv and Cc through Orifice meter.
3. Calculate the Coefficient of Friction through Pipe Set Apparatus.
4. Study of Viscosity of given oil through Redwood Viscometer.
5. Study of Coefficient of friction between flowing Apparatus.
6. Calculate the Critical Reynolds's Number through Pipe Set Apparatus.
7. Determination of overall efficiency of Pelton Turbine.
8. Determination of overall efficiency of Francis Turbine.
9. Determination of overall efficiency of Kalan Turbine.

Laboratory Course Outcomes: After successful completion of this course students will be able to:

CO1. **Experiment** with flow measurement devices like venturimeter and orifice meter.
CO2. **Estimate** the friction and measure the frictional losses in fluid flow.
CO3. **Predict** the coefficient of discharge for flow through pipes.
CO4. **Evaluate** pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe.
CO5. **Calculate** the Critical Reynolds's Number through Pipe Set Apparatus.
CO6. **Compare** the overall efficiency of various types of turbines.

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120305: Software Lab

Category	Title	Code	Credit-1			Practical Slot
Departmental Lab Core-DLC	Software Lab	120305	L	T	P	Max.Marks-50 Min.Marks-16 .
			-	-	2	

Course Pre-Requisites:
Engineering Graphics

Course Objectives: To make the students:

1. Develop an ability to make familiar with 2D, 3D modelling and simulation software
2. Develop an ability to create and modify complex 2D and 3D entities using CATIA software
3. Develop creative skills in developing new ideas.

SYLLABUS:

Auto CAD: Auto CAD interface, work space setting, Basic commands, viewports and printing.
Snaps: snap to grid, show to grid. Orthographic polar snap, object snap, dynamic UCS.
2D and 3D commands: Trim, extend, Offset, move, mirror, scale, rotate, extrude, union, subtract etc. commands. Units: properties, measure and dimension.

CATIA concepts: Display-Tree appearance, Three button move, view tool bar, Normal standard and shading view**,** 2D toolbar, sketch tools, constraint, profile, operation.
Toolbar: Sketch based features toolbar, commands-Pad, Pocket, shaft, groove, holerib etc. Dress up feature, Transformation features, Boolean operation.

Simulation: Assembly and simulation in CATIA, Linear and rotational motion, Nut-bolt mechanism simulation

Course Outcomes: After successful completion of this course students will be able to:
CO1 Describe AutoCAD and CATIA toolbars
CO2 Summarize 2D and 3D commands
CO3 Solve real time problems using AutoCAD and CATIA software
CO4 Analyse various mechanical engineering problems.
CO5 Evaluate technical drawings of machine assemblies as a design engineer
CO6 Generate 2D and 3D solid models with new features in machine elements

Text Books and Reference books:

1. Franke& Roger: Modelling and simulation for chemical engineering, Willey Interscience
2. Luyben-Process modelling simulation and control for chemical engineers, IInd, McGraw Hill,1989
3. Fundamentals of Engineering drawing Interactive graphics by Luzzader WJ, Duff JM;PHI
4. A general guide to computer aided design and drafting-CAD by Duggal, Vijay, cadd primer; CAD malimax publications.

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120401: Theory of Machines-II

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Theory of Machines-II	120401	2	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Pre-Requisite:
Engineering Graphics (Subject Code – 100105)
Mechanics of Materials (Subject Code – 120302)
Theory of Machines (Subject Code – 120303)

Course Objectives: To make the students:

1. Understand the basics of synthesis of simple mechanisms.
2. Apply fundamental of mechanics to machines elements which include gear, gear train, cams etc.,
3. Develop an ability to design a system, component, or process to meet desired needs within realistic constraints.

Syllabus

Unit- I Gears: Classification, Terminology, Law of gearing, Forms of teeth, Tooth profile, Cycloidal and Involute tooth forms, path of contact, teeth in contact, Interference. Spur, Helical, Spiral, Worm and Bevel gears.

Unit- II Gear Trains: Simple, Compound, Reverted and Epicyclic gear trains, Velocity Ratio. Various applications of gear trains - Motor car gear box, Differential mechanism, cyclometer mechanism etc.

Unit-III Balancing: Introduction, Balancing of rotating and reciprocating masses, Locomotive balancing, Balancing of multi cylinder in line engines, Balancing of radial engines, Direct and reverse crank method of balancing.

Unit-IV Cams and Cam Dynamics: Introduction, Classification of cams and followers, Terminology, Displacement, Velocity and acceleration diagrams for different follower motions, Synthesis of cam profiles. Cams with specified contours, Cam dynamics.

Unit-V Synthesis of Linkages: Introduction, Types, Number and Dimensional synthesis, Function Generation, Chebychev's spacing of accuracy points, Synthesis with three accuracy points of 4-bar and slider-crank mechanisms, Synthesis of crank rocker mechanisms with optimum transmission angle, Path generation.

Course Outcomes: After successful completion of this course students will be able to:

CO 1.Identify the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
CO 2.Classify various components of machines like gear, gear train cam etc
CO 3.Solve numerical problems of various components of machines like gear, gear train cam etc.
CO 4.Analyze the forces and motion of complex systems of linkages, gears and cams.

CO 5. **Evaluate** the applications of components e.g. gear, gear train, balancing, cam etc. and select appropriate machine elements for the required applications.

CO 6. **Design** the mechanism or components to justify the demands of work such as linkage, cam, gear, gear train mechanism etc.

Text & References Books:

1. Design of Machinery **by** Robert L.Norton; TATA McGraw Hill.
2. Theory of Machines **by** S S Rattan; Tata McGraw Hill.
3. Theory of Machines **by** R S Khurmi; J K Gupta; S. Chand.
4. Mechanism & Machine Theory **by** Ashok G. Ambekar; PHI (Prentice-Hall India).
5. Theory of Machines **by** Sadhu Singh; Pearson Education.
6. Theory of Machines and Mechanisms **by** P L Ballaney; Khanna Publishers.
7. Theory of Machines **by** R K Bansal; Laxmi Publications .

NPTEL Link for Theory of Machines-II

http://nptel.ac.in/courses/112104121/1 and http://nptel.ac.in/courses/112104114/

List of experiments

1. Study of various types of gears.
2. Study of various types of gear trains.
3. Balancing of rotating masses.
4. Balancing of reciprocating masses.
5. Study of kinematic synthesis of mechanisms.
6. Study of cams and followers.
7. To draw cam profile, velocity and acceleration diagrams of a given cam-follower mechanism.

Laboratory Course Outcomes: After the completion of the course Lab student will be able to

CO1 **Identify** the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism.
CO2 **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive
CO3 **Determine** the degrees-of-freedom (mobility) of a mechanism
CO4 **Apply** the fundamental principles of statics and dynamics to machinery.
CO5 **Evaluate** the dynamic forces for various machines.
CO6 **Analyze** the fundamentals of machines for desired kinematic or dynamic performance.

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120402: Design of Machine Elements

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Design of Machine Elements	120402	2	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Note: Use of PSG Design Data book is permitted in exam.

Course Pre-Requisites:
Mathematics-I(Subject Code – 100102)
Mechanics of Materials(Subject Code – 120302)

Course Objectives: To make the students:

1. Able to identify, formulate and solve design engineering problems.

2. Develop an ability to use the techniques, skills and modern design engineering tools necessary for engineering practice.

3. Demonstrate the ability to make proper assumptions, perform correct analysis while design upon various mechanical machine elements.

Syllabus

Unit-I Introduction: Design process, Factor of safety, design standards and units, Material selection in Mechanical Design, surface finish symbols, Surface Roughness, limit, fit, and tolerance, Gauge design, Tolerance analysis in manufacturing and assembly, Design for Manufacturability, Comparison between conventional design process and modern design process

Unit-II Bolted, Riveted and Welded joints: Definition, Nomenclatures, Classifications, Applications, Methods of joining, Loadings & Failures, Design procedures, Eccentric loading problems.

Unit-III Cotter and Knuckle joints: Definitions, Nomenclature, Classifications, Comparison between keys and cotters, Design of Socket and spigot cotter joint, Sleeve type Cotter joint, Cotter with Gib, Knuckle Joint, Suspension link, Pin joint, Adjustable joint, Turn-buckle.

Unit-IV Shafts, Keys and Couplings: Definitions, Classifications and Applications. Design under various loads and cases.

Unit-V Theories of Failures: Maximum normal stress and shear stress theory, maximum normal strain and shear strain theory, maximum distortion energy theory. Applications of theories to different material. Introduction to 2D, 3D modules and tools, Fundamentals and applications of CAD/CAM. Concept of computer aided drafting and Machine drawing.

Course Outcomes: After successful completion of this course students will be able to:

CO1 Describe the basic design process and function of Permanent and temporary joints used in Machine Design

CO2 Summarize the design techniques, skills and tools used in design

CO3 Solve the various design engineering problems by formulate and proper assumptions for practice.

CO4 Analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts

CO5 Evaluate the cases of Temporary and permanent joints problems successfully

CO6 Create design techniques for a mechanical component under variety of environmental and service conditions.

Text &Reference Books

1. Mechanical Engineering Design byShigley JE et al; TMH
2. Machine Design byMubeen
3. Design of Machine elementsbyBhandari VB; TMH
4. Text Book of Machine Drawing byJohn KC; PHI Learning
5. Engineering design – George Dieter, MGH, New York.
6. Machine Drawing byBhat, ND; Charotar.
7. Machine Drawing byNarayana and Reddy; New age, Delhi.
8. Design data book **by** PSG
9. Fundamental of Engg Drawing Interactive Graphics **by**Luzzader WJ, Duff JM; PHI.
10. Mechanical design data book **by** Mahadevan and Reddy's;CBS

NPTEL Link for Design of Machine Elements

http://nptel.ac.in/courses/112105124/

List of Experiments

1. Design and drawing of Single, double and triple riveted joint
2. Design and drawing of Single and double strap butt joint
3. Design and drawing of Welded joint
4. Design and drawing of Socket and Spigot cotter joint
5. Design and drawing of Gib and Cotter joint.
6. Design and drawing of Knuckle joint
7. Study of Theories of failure
8. Design and drawing of Solid and hollow shaft
9. Design and drawing of Rigid coupling
10. Design and drawing of Flexible coupling

Laboratory Course Outcomes: After the completion of the course Lab students will be able **to**

CO1 **Design** and analysis the different part of an I.C Engine like Piston, cylinder, connecting rod , crank shafts , flywheel.

CO2 **Compare** the materials used in designing the automobile engine parts.

CO3 **Use** the software like AUTO CAD , CATIA , PRO/E, SOLID WORKS.

CO4 **Select** the spring for a proper application also can select the proper material of spring.

CO5 **Design** the different types of gear like spur gear, helical gear , worm gear , bevel gear and also able to know their practical applications.

CO6 **Create** a gear box for modern Automotive vehicles and can use this for the benefits of society.

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Department of Mechanical Engineering

For batch admitted in Academic Session 2017-18

Manufacturing Processes

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Manufacturing Processes	120403/190404	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives: To make students:

1. Able to learn the various methods and types of castings, welding processes, sheet metal forming, powder metallurgy
2. Able to **e**xamine the principles associated with basic operations involving the forming, machining and welding of engineering materials;
3. Aware of the necessity to manage manufacturing processes and systems for the best use of material and human resources.

Course Pre-Requisites:

Manufacturing Practice (Subject Code – 100106)

Syllabus

Unit-I Casting: Brief History, Basic principle & survey of casting processes.Sand casting, pattern materials, and allowances.Green and dry moulding, moulding methods, moulding sand properties and testing.Elements of mould and design considerations. Cores use, core materials and core making practice. Die, investment and centrifugal casting processes. Melting practice and concepts in solidification.Inspection and defects analysis.

Unit-II Forming: Elastic and plastic deformation, Concept of strain hardening. Rolling, forging, extrusion, spinning, wire and tube drawing processes, machines and equipment's, parameters and force calculations.

Unit-III Sheet Metal Working: Role of sheet metal components.Cutting mechanism. Description of cutting processes like blanking. Piercing, lancing etc. Description of forming processes like bending cup drawing, coining, embossing etc. Basic elements of presses for sheet metal working. Punch and Die clearances and die elements.

Unit-IV Welding: Principle of welding, soldering, brazing and adhesive bonding.Survey of welding and allied processes. Arc welding: power sources and consumables. MMAW, TIG& MIG processes and their parameter selection. Resistance Welding: principle and equipment. Spot, projection and Seam welding processes, Gas welding and cutting: Processes and equipment.

Unit-V Powder Metallurgy: Powder manufacturing, compaction and sintering processes. Advantages and applications of P/M. Manufacturing of Powder metallurgy components.

Course Outcomes: After successful completion of this course students will be able to:

CO1- Describe the different types of manufacturing processes and their applications.

CO2- Identify suitable manufacturing process to achieve the required product shape with the aim of avoid defects, material and time wastage.

CO3-Illustrate the advantage and limitations of various manufacturing processes with regard to shape formation and surface quality.

CO4-Analyse the manufacturing processes for given problem and able to select an appropriate process according to a specific requirement.

CO5-Evaluate the procedures and techniques involved for the manufacturing of components for its optimization.

CO6-Propose a simplified manufacturing processes with the aim of reduction of cost and manpower.

Text &Reference Books

1. Jain R.K., Production Technology, Khanna Publishers, 2001.
2. Hajra Choudhry, Elements of Workshop Technology, Vol – II Media Promoters & Publishers, 1994.
3. Production Technology by HMT, Tata McGraw-Hill.
4.Chapman, W.A.J., Workshop Technology, Vol - II, Oxford & IBH Publishing Co. Ltd.,
5. Manufacturing Processes by Amstead, B.H., P.F. Oswald and M.L. Begeman, John Wiley and Sons Inc., New York.
6. Manufacturing Technology Vol. 1 by P.N. Rao.
7. Modern Manufacturing Process Engineering by Neibel, B.W., Alan B. Draper and R.A. Wysk, McGraw-Hill Publishing Co., New York.
8. Manufacturing Engineering and Technology by Kalpakjian, S, Addison-Wesley Publishing Co., New York.
9. Materials and Processes in Manufacturing by E. Paul DeGarmo, J. Temple Black, and Ronald Kohser, Macmillan Publishing Co., New York.
10. Introduction to Manufacturing Processes John A. Schey, McGraw-Hill Book Co., New York.

NPTEL Link for Manufacturing Process

http://nptel.ac.in/courses/112107145/

List of Experiment

1. Performance on mold making of Simple component
2. Performance on pattern making of Simple component
3. Performance on Metal Casting of Simple component
4. Performance on Welding of simple workpiece (Example Arc Welding)
5. Performance on Sheet metal work of Simple component
6. Performance on hot forging of Simple component

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Engineering Thermodynamics

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Engineering Thermodynamics	120404/190403	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objective: To make students able to:

1. Understand the nature and role of the various thermodynamic properties of matter.
2. Represent a thermodynamic system by a control mass or control volume and identify work and/or heat interactions between the system and surroundings.
3. Recognize the different forms of energy and restrictions imposed by the laws of thermodynamics on conversion from one form to another.

Course Prerequisites:

Basic Mechanical Engineering (Subject Code – 100204)

Syllabus

Unit–I Basic Concepts: Thermodynamics, Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, Statement and significance, Concept of an Ideal gas, Gas Laws, Avogadro's Hypothesis, Heat and work transfer. First law of thermodynamics –Statement of first law of thermodynamics, first law applied to closed system undergoing a cycle, Process analysis of closed system flow process, Flow energy, Steady flow process analysis of closed system processes, Limitations of first law of thermodynamics.

Unit –II Properties of pure substances :- P-V-T surfaces, h-s , T-S, P-V , P-h, T-V diagrams of pure substance, saturated and sub-cooled liquid, superheated vapour, quality of steam, Mollier diagram, steam table, different processes, measurement of quality of steam

Unit –III Second law of thermodynamics: Heat engine, Heat reservoir, Refrigerator, Heat pump, COP, Carnot's theorem, Carnot's cycle, Efficiency of Carnot's cycle, Statement of second law, Reversible and Irreversible processes, Consequences of Second law.

Unit –IV Availability and Irreversibility: Entropy, Entropy change of Ideal gas, Available energy, T-S diagram, Availability and Irreversibility.

Unit- V Thermodynamics Relations: Thermodynamics relations, e.g Maxwell relations and their applications.

Course Outcomes: After successful completion of this course students will be able to:

CO1: Define energy interactions between system and surroundings.

CO2: Correlate the law of thermodynamics to real life applications

CO3: Apply the laws of thermodynamics to analyze boilers, heat pumps, refrigerators, heat engines, compressors and nozzles

CO4: Investigate the effectiveness of energy conversion device in mechanical power generation

CO5:.**Analyze** air standard cycles applied in prime movers.

CO6: Describe benefits of improvements to thermodynamic systems.

Text &Reference Books:

1. Engineering thermodynamics **by** P.K. Nag
2. Thermal engineering **by** R.K. Rajput
3. Thermal engineering **by** P.L. Ballaney
4. P L Dhar Thermal Engineering

NPTEL Link for Engineering Thermodynamics

https://onlinecourses.nptel.ac.in/noc18_ch03/preview

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120405: Production Lab

Category	Title	Code	Credit-2			Practical Slot
Departmental Lab Core-DLC	Production Lab	120405	L	T	P	Max.Marks-50 Min.Marks-16
			-	-	4	

Course Objective:

1. To demonstrate the fundamentals of machining processes and machine tools.
2. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
3. To apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, etc.

List of Experiments:

1. Step Turning and Taper Turning on Lathe.
2. Threads Cutting and Knurling on Lathe.
3. Machining Flat Surface using Shaper Machine.
4. Manufacturing of Spur Gear using Milling Machine.
5. Making Internal Splines using Slotting Machine.
6. Hole on work piece through Drilling.
7. Grinding of Single Point Cutting Tool
8. Slot / Groove cutting using shaping machine.
9. Performance on mold making of Simple component.
10. Performance on pattern making of Simple component.
11. Performance on Metal Casting of Simple component.
12. Performance on Welding of simple work piece (Example Arc Welding)
13. Performance on Sheet Metal work of Simple component.
14. Performance on hot forging of Simple component

Laboratory Course Outcomes: After the completion of the course Lab student will be able to:

CO1 Define the different conventional method of material removal and function of different parts.
CO2 Apply the theory of metal cutting in experiments.
CO3 Perform step, taper turning, knurling and threading.
CO4 Produce stepped surface using shaper and keyway using milling machine.
CO5 Demonstrate knowledge of different machine tools used in machine shop.
CO6 Evaluate the chip thickness ratio, shear angle and material removal rate.

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Industrial Engineering

Category	Title	Code	Credits: 3			Theory Paper
Departmental Core-DC	Industrial Engineering	120501/190501	L	T	P	Max.Marks-70 Min.Marks-22
			3	-	-	Duration-3hrs.

Course Objectives: To make the students understand:

1. Professional, technical managerial, or leadership roles within industrial organizations.
2. The knowledge through discovery, synthesis, and integration for the betterment of their organization or society

Syllabus

UNIT-I

Production Systems and Productivity: Production Management: design of production systems (product, job shop and batch). Definition and types of productivity, Measurement of productivity, factors affecting the productivity and productivity improvement programs.

Production Planning and Control: Objective, importance, need and function of production planning and control, planning, routing, scheduling, dispatching, follow up & progress report, production planning and production control.

UNIT-II

Forecasting techniques: Need and type of forecasting, factors affecting forecasting, forecasting in decision making, time series analysis, demand patterns, qualitative methods- measures of forecast accuracy and error analysis in quantitative forecasting.

Capacity and aggregate planning: Capacity planning: capacity measurement, long-term and short term strategies, aggregate production planning, and graphical method to choose aggregate plan.

UNIT-III

Master Production Scheduling and MRP: Functions, planning horizon and planning periods for master production schedule, types of master production schedule, Bill of Material, Independent Demand versus dependent demand, Functions of material requirements planning and manufacturing resource planning (MRP I and MRP II), inputs for MRP system, performance characteristics of MRP system, materials requirement planning explosion.

UNIT-IV

Product Design and Development: Principles of good product design, tolerance, quality and cost considerations, product life cycle, standardization, simplification, diversification, value engineering and analysis, methodology, applications, concurrent engineering; comparison of production alternatives. **Facility Locations and Plant Layout:** Facility location factors and evaluation of alternate locations; qualitative aspects, quantitative models for layout decisions, types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing, materials handling systems.

UNIT-V

Inventory Control – Objectives and functions, need and classifications- codification and standardization ABC analysis, deterministic inventory models, quantity discount; perpetual and periodic inventory control systems. Probabilistic inventory management, economic ordering quantity procurement cost, carrying charges, lead-time, re-order point.

Project management – PERT and CPM.

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Course outcomes: After learning the course the students should be able to:

CO1. **analyze** and measure productivity.
CO2. **acquire** the knowledge and understanding regarding Production planning and Controlled required for industry to analyze the engineering problems.
CO3. **utilize** the operation research techniques as a problem solving techniques.
CO4. **gives** practice through various Management and Operation Tools for Improving Quality and Quantity.
CO5. **solve** various kinds of problems or issue faced by service and manufacturing industries like economic consideration, optimum utilization of resources, productivity.
CO6. **get** the solutions for materials requirement planning.

Text Books:

1. Industrial Engineering and Management by O. P. Khanna, Latest Edition.
2. Manufacturing planning and control for SCM by Vollmann; TMH, Latest Edition.
3. Purchasing & Materials Management by Dobler & Lee, PHI, Latest Edition

Reference Books:

1. Operations Management by Krajewski, L. J., Ritzman, L. P. and Malhotra, M. K., Prentice Hall, New Delhi; Latest Edition.
2. Production/Operations Management by Ebert, J and Adams, D.J., Prentice Hall of India, New Delhi; Latest Edition.
3. Production and Operations Management: manufacturing and services by Chase, R. B., Aquilano, N. J. and Jacob, F. R., TMH, New Delhi; Latest Edition .
4. Modern Production/Operations Management by Buffa and Sarin, Wiley India; Latest Edition.

List of Open Source Software/learning website:

I. http://nptel.ac.in/courses/110106045/
II. http://www.newagepublishers.com/samplechapter/001233.pdf
III. http://onlinelibrary.wiley.com/doi/10.1111/poms.12315/pdf

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Metal Cutting and Machine Tools

Category	Title	Code	Credit: 3			Theory Paper
			L	T	P	Max.Marks-70
Departmental Core-DC	Metal Cutting and Machine Tools	120502/ 190502	2	1	-	Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students understand:

1. The fundamental knowledge and principles in material removal processes.
2. The fundamentals and principles of metal cutting to practical applications through
3. The fundamentals of machining processes and machine tools.

Syllabus

Unit-I Mechanics of Metal Cutting: Introduction to manufacturing and machining, Classification of metal removal processes, Geometry of single point cutting tool and tool angles. Tool nomenclature. Conversion of tool angles from one system to another, Mechanics of chip formation and types of chips, chip breakers. Orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting. Thermal aspects of machining and measurement of chip tool interface temperature. Friction in metal cutting. **Machinability & Cutting Fluids:** Concept and evaluation of machinability, tool life, mechanism of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability. Advanced Cutting Tool Materials, Cutting Fluids

Unit-II General Purpose Machine Tool: Constructional detail of milling, shaper and planer machines. Tooling, attachments and operations performed, selection of cutting parameters, calculation of forces and time for machining. Broaching operation. Capston and turret Lathes, single and multiple spindle automates, operations, planning and tool layout.

Unit-III Abrasive Processes & surface Finishing: Abrasive, natural and synthetic, manufacturing nomenclature. Selection of grinding wheels, wheel mounting and dressing. **Surface Finish:** Elements of surface roughness, evaluation and representation and measurement of surface roughness, relationship of surface roughness to production methods.

Unit-IV Gear Manufacturing Processes: Introduction, materials, methods of gear manufacturing, Gear Milling, Gear Hobbing& Gear Shaping Machine Tools and processes. Modern gear manufacturing methods, gear inspection.

Unit-V Non Conventional machining: Benefits, general application and survey of Non-conventional machining processes. Mechanism of metal removal, tooling and equipment and specific applications of EDM, LBM, EBM, ECM, USM, AJM, WJM, AWJM, PAM processes

Course Outcomes: After successful completion of this course students will be able to

CO1: **apply** cutting mechanics to metal machining based on cutting force and power consumption.
CO2: **operate** lathe, milling machines, drill press, grinding machines, etc.
CO3: **select** cutting tool materials and tool geometries for different metals.
CO4: **choose** appropriate machining processes and conditions for different metals.
CO5: **optimize** parameters for material removal in unconventional machining processes.
CO6: **identify** the process parameters, their effect and applications of different processes

Text Books

1. Fundamentals of Metal Cutting and Machine Tool **by** Boothroyd Geofery; McGH, Kogakuha Ltd.

2. Production Technology **by** Jain, R.K. and Gupta, S.C; Khanna Publishers.

Reference Books:

1. Workshop Technology **by** Chapman, Volume I, II, & III, ELBS.
2. Production Technology **by** HMT; McGraw Hill, New Delhi.

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Heat and Mass Transfer

Category	Title	Code	Credits: 3			Theory Paper
Departmental Core-DC	Heat and Mass Transfer	120503/190503	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	2	

Course Objectives: To make the students understand:

1. the comprehensive of physical science and its fundamentals applicable to the engineering discipline of heat and mass transfer.
2. the fundamentals of heat transfer mechanisms in fluids and solids.

Syllabus

UNIT-I Fundamental of Heat Transfer: Modes of heat transfer, Fourier's, Newton's and Stefan Boltzmann's law, thermal conductivity and its variation with temperature, film coefficient of heat transfer, general heat conduction equations, Steady state heat transfer: Thermal resistances and conductance, overall Heat transfer Coefficient, Heat transfer through plane and composite wall, hollow and composite hollow cylinder and sphere, thermal diffusivity, one dimensional steady state conduction with heat generation , critical thickness of insulation. Unsteady State Heat Transfer: Transient and periodic conduction, Lumped System Analysis, heating and cooling of bodies with known temperature distribution, response of thermocouple.

UNIT-II Convection Heat Transfer: Introduction to Free and Forced Convection, laminar and turbulent flow, forced convection through hydrodynamic and thermal boundary layers, analysis of hydrodynamic and thermal boundary layer. Empirical equations of convection heat transfer. Heat Transfer in a circular pipe (forced convection). Applications of dimensional analysis to free and forced convection. Reynolds Number, Prandtl Number, Grashoff Number, Nusselt numbers, and Boit Number.

UNIT-III Heat Exchangers: Basic types of heat exchanger. Logarithmic Mean Temperature Difference (LMTD), fouling factor, heat exchanger effectiveness, NTU Methods. Extended surfaces: Pin-Fin and rectangular fin of uniform cross section. Effectiveness and efficiency of Fin. Use of fin analysis for measuring, thermometric error, triangular and parabolic profile.

UNIT-IV Thermal radiation: Basic concept. Monochromatic and total emissive power, absorptivity, reflectivity and transmissivity, Kirchhoff's law, Concept of Black & Grey bodies.Plank's distribution law.Wien's displacement law.Steffen – Boltzmann law, Concept of Shape factor. Condensation heat transfer: Introduction, process, Theory of laminar film condensation. Nusselt'sTheory.Drop wise condensation. Influence of the presence of non-condensable gases. Boiling heat transfer: Nature, Boiling regimes, Bubble size consideration, bubble growth and Collapse.Critical diameter, Rosen how Correlation.

UNIT V Diffusion Mass Transfer: Fick's law. Steady state diffusion of gases and liquids through solids, Equi-molal diffusion, isothermal diffusion, isothermal evaporation of water into air. Mass transfer coefficient.**Convective Mass Transfer:** Mass transfer through boundary layer. Analogy between momentum heat & mass transfer.Dimensional analysis, application to convective mass transfer.Forced convection mass transfer in laminar and turbulent flow through tubes.Simultaneous heat and mass transfer.

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Course Outcomes: After successful completion of this course students will be able to:

CO1. state principles of heat and mass transfer to basic engineering systems
CO2. develop basic concepts of heat transfer, differentiate between heat transfer and thermodynamics, modes of heat transfer (rates) i.e. Conduction, Radiation and convection.
CO3. analyze and **solve** heat transfer problem of conduction, convection and radiation
CO4. apply physics of heat transfer in the processes like Condensation and 'Boiling' and in applications like 'Fins' and 'Heat-Exchangers'. Analyze and design heat exchangers
CO5. formulate and **solve** one dimensional conduction with and without heat generation, convection and radiation heat transfer problems.
CO6. create solution techniques which include both closed form and numerical methods of heat conduction and Convection.

Text Book:

1. Kumar D. S, Heat & Mass Transfer, Latest Edition, Katson Publication.

2. Rajput R. K., Heat & Mass Transfer, Latest Edition, S. Chand Publication.

References Books:

1. Arora&Domkundwar, A course in Heat & Mass Transfer, Latest edition, DhanpatRai& Co. Publication.
2. Nag P K, Heat Transfer, Latest Edition, McGrawhill
3. Holman J. P., Heat Transfer, Latest Edition, TMH.
4. Kreith& Bohn, Principles of Heat Transfer**,** Latest Edition, CL Engineerig Publication.
5. CengelYunus A., Heat and Mass Transfer, Latest Edition,TMH.
6. Thirumaleshwer M., Heat and Mass Transfer **by**, Latest Edition, Pearson.

List of Experiments: -

1. Determination of Thermal Conductivity of Metal Rod.
2. Determination of Thermal Conductivity of Insulating Powder.
3. Measurement of Emissivity.
4. Determination of Stefan-Boltzman constant.
5. Determination of Heat Transfer coefficient by Pin-Fin Apparatus.
6. Determination of Effectiveness of Shell and Tube heat exchanger.
7. Determination of effectiveness of Parallel and Counter Flow Heat Exchanger.
8. Determination of heat transfer coefficient by Forced Convection.
9. Determination of Heat Transfer coefficient by drop and film wise condensation method.

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120504: Thermal Engineering

Category	Title	Code	Credit -3			Theory Paper
Departmental Core-DC	Thermal Engineering	120504	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	2	

Syllabus

UNIT I -Air Standard Cycles And Vapor Power Cycles: Carnot, Sterling, Ericssion, Otto, Diesel, Dual cycles and determination of their air standard efficiencies and their comparison. Brayton cycle, Atkinson cycle.PVT relationship, Mixture of ideal gases Properties of mixture of gases**.**Vapor Carnot cycle and its limitations, Rankine cycle and modified Rankine cycle, actual vapor power cycle, Reheat cycle, ideal regenerative cycle, actual regenerative cycle, Reheat – regenerative cycle, feed water heaters , working fluids in vapor power cycle, binary vapor cycles, efficiency of coupled cycles , process heat, efficiencies in power cycles. Basics of condensers.

UNIT II - Engine Construction, Operation And Performance:
Basics of CI and SI Engines, Valve timing diagram, Firing order and its significance - relative merits and demerits of SI and CI engines. Two stroke engine construction and operation. Comparison of four-stroke and two-stroke engines. Performance parameters, Heat balance. Testing of engine.

UNIT III - Combustion In SI And CI Engines:
Combustion process in IC engines.Stages of combustion, Flame propagation, velocity and area of flame front.Rate of pressure rise - Cycle to cycle variation – Abnormal combustion - Theories of detonation - Effect of engine operating variables on combustion.Combustion chambers for SI and CI engines, Importance of air motion - Swirl, squish and turbulence - Swirl ratio. Fuel air mixing - Stages of combustion - Delay period - Factors affecting delay period, Knock in CI engines - methods of controlling diesel knock.

UNIT IV – Turbines And Pumps
Classification, Pelton, Francis and Kaplan turbines, vector diagrams and work done Draft Tubes, governing or water turbines, Impulse staging, velocity and pressure compounding utilization factor, analysis for optimum U.F. Curtis stage, and Rateau stage, including qualitative analysis. Effect of blade and nozzle losses on Vane efficiency, Stage efficiency.Analysis for optimum efficiency vortex types of flow, flow with constant reaction. Application of dimensional analysis, similarity to turbines and pumps, Classification, advantage over reciprocation type, definition of manometric head gross head, static head, vector diagram and work done. Performance and Characteristics of turbines and pumps.

Unit V Refrigeration and Air Conditioning
Reversed Brayton Cycle, Bell-Coleman Cycle.Air Cycles for Aircraft Refrigeration, Properties Requirement, & Applications of Refrigerants.CFC & HFC Refrigerants.Simple vapour Absorption Systems-Electrolux Refrigerator, Refrigerants, Ozone depleting refrigerants.
Vapour Compression System: Simple Systems, Multi pressure systems. Compound Compression, Multi Evaporator Systems. Cascade Systems. Vapour absorption system,

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Air Conditioning: Introduction to Psychometry and Air Conditioning.

Course Outcomes: After successful completion of this course students will be able to:

CO1: selection of various types of fuels based on required applications.

CO2: outlining the basics of Refrigeration and Air conditioning

CO3: solve analytical problems of thermal engineering.

CO4: compare different turbo machines depending on their behavior and their merits and demerits.

CO5: select proper fluid machines for appropriate operation.

CO6: design of various types of combustion chambers for Internal Combustion Engines.

Text Books:

1. Ganesan V, "Internal combustion engines", Latest edition, Tata McGraw Hill Education,
2. Arora C. P. "Refrigeration & Air-Conditioning" Latest edition, Tata McGraw Hill Education,
3. Rajput R. K, "A textbook of Thermal Engineering", Latest edition, Laxmi Publications.

References Books:

1. John. B, Heywood, "Internal Combustion Engine Fundamentals", Latest edition, McGraw Hill Publishing Co., New York,
2. Ramalingam K. K, "Internal Combustion Engines", Latest edition, Scitech Publications.
3. Sharma S. P, Chandramohan, "Fuels and Combustion", Latest edition, Tata McGraw Hill Publishing Co.
4. Mathur and Sharma, "A course on Internal combustion Engines", Latest edition, DhanpatRai& Co.
5. Edward &Obert, "Internal Combustion Engines and Air Pollution", Latest edition, Intext Education Publishers.

List of Experiments:

1. Performance test of two stroke petrol engine and four stroke petrol engine.
2. Performance test of two stoke diesel engine and four stroke diesel engine.
3. Demonstration of C.O.P. and Performance of Air-Conditioner.
4. Determination of C.O.P. in Vapour compression Refrigeration system
5. Demonstration of C.O.P. and other performance parameters for Mech. Heat Pump.
6. Study of Governing of Pelton, Francis, Kaplan Turbine
7. Determination of Specific quantities inPelton, Francis, Kaplan Turbine
8. Study of Axial Compressor

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120505: Machine Design

Category	Title	Code	Credit -3			Theory Paper
Departmental Core-DC	Machine Design	120505	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	2	

Note: Use of PSG Design Data book is permitted in exam.

Course Pre-Requisites:

1. Mechanics of Materials(Subject Code – 120302)
2. Design of Machine Elements (Subject Code - 120402)

Course Objectives: To make students:

1. Develop an ability to identify, formulate and solve design engineering problems.
2. Develop an ability to use the techniques, skills and modern design engineering tools necessary for engineering practice.
3. Demonstrate the ability to make proper assumptions, perform correct analysis while design upon various mechanical machine elements.

Syllabus

UNIT-I

Stress concentration & fatigue:

Stress Concentration-causes, effect in tension, bending and torsion, mitigation, **Fatigue**- cyclic loading, endurance limit, S-N curve, concentration factor, notch sensitivity, design consideration, Goodman and modified Goodman's diagram, Soderberg's equation, Gerber's parabola, design for finite life, cumulative fatigue damage factor.

UNIT-II

Spring: Function, classification, Rate, curvature of coil, scale, resilience, material, Stresses and deflection equations of helical springs, design of compression and tension springs, torsion springs, fatigue loading on springs, surge in spring, critical load, spiral springs, design of leaf spring.

UNIT-III

Gears: Design of Spur, Helical, worm and Bevel Gears: Force analysis, Selection of material, Beam and wear strength, Form or Lewis factor, Dynamic load-Barth equation and Buckingham equation, consideration for maximum power transmitting capacity, Gear lubrication.

UNIT-IV

Sliding contact bearings:

Classification, Selection, Viscosity of Lubricants, Materials, Types, Petroff's relation, loads on bearing, Design, Advantages, Disadvantages, Limitations, Heat Dissipation.

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UNIT-V

Rolling contact bearings:

Designation, Types, Friction effect, loads, Fatigue, Deflection & deformation, Selection, bearing life.

Course Outcomes: After successful completion of this course students will be able to:

CO1:Describe the design procedure used in automotive industry to design the engine parts

CO2:Classify the different types of spring, bearing and Gears

CO3:Choose the right strategy for designing the machine components based on material and methods

CO4:Apply the design procedure for solving and drafting the different design of machine elements

CO5:Compare the various curves and design procedure used

CO6:Selection of machine elements under various loading and environmental conditions.

Text Books

1. Shigley, J.E., and CharlesMechanical Engineering Design; TMH
2. Bhandari VB, Design of Machine elements; Tata McGraw Hill Book Co.

Reference Books

1. John KC,Text Book of Machine Drawing; PHI Learning.
2. Machine Design by Mubeen, Pearson.
3. Engineering design by George Dieter; McGraw Hill.
4. Bhatt, ND,Machine Drawing; Charotar.
5. Kulkarni, S.G., Machine Design, McGraw Hill.
6. Narayana and Reddy,Machine Drawing; New age publication.
7. Design data book, PSG College of Technology, Coimbatore
8. Luzzader, WJ, Duff, JM,Fundamental of Engineering Drawing Interactive Graphics; PHI.
9. Mahadevan, Reddy's,Mechanical design data book;CBS Publisher.

NPTEL Link for Design of Machine Elements

https://nptel.ac.in/syllabus/112106137/

https://nptel.ac.in/downloads/112105125/

List of Experiments

1. Design and drawing of helical spring.
2. Design and drawing of Spur gear.
3. Design and drawing of Helical gear.
4. Design and drawing of Worm gear.
5. Design and drawing of bevel gear.
6. Modelling and simulation of Gear box.
7. Study of Sliding Contact Bearings and Ball bearing and its selection
8. Design and drawing of Antifriction Bearing.
9. Design and drawing of Journal Bearing.
10. Assembly drawing of the Foot step bearing.

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120601: Advanced Production Technology

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Department Core-DC	Advanced Production Technology	120601	2	-	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the student understand:

1. the application of computers in various aspects manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity and reduces the unnecessary costs.

2. the fundamental of automation and brief history of robot configurations, sensors, end effectors, vision systems and to impart knowledge of various additive manufacturing Technologies for application to various industrial needs.

Pre-requisite: Manufacturing Processes, Metal cutting

Syllabus

UNIT-I FUNDAMENTALS OF NC, CNC & DNC MACHINES: Principles of numerical control, types of CNC machines, features of CNC systems, integration of CNC machines in CIM environment, Direct numerical control (DNC), Open loop system, Closed loop system.

UNIT-II CONSTRUCTIONAL FEATURES OF CNC MACHINES and PART PROGRAMMING: Features of CNC Machines such as Structure, Drive Mechanism, Main drive, feed drive, Spindle Motors, Axes motors, Tool magazines, ATC, Control systems, Feedback devices, Input media and coding formats. Manual part programming for Lathe, Drilling and Milling machines, Cutter diameters and Length compensation. Computer assisted part programming Languages APT, EXPAT, ADAPT, COMPACT .Computer numerical control, direct and distributed numerical control, adaptive control.

UNIT-III GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS: - GT Part Families, Classification & coding, M/C Cell Design, Benefits of GT, FMS Workstations, Material Handling & Storage Systems, Computer Control System, Planning of FMS Analysis Methods. Basic Elements of an Automated system, Levels of Automation.

UNIT-IV INDUSTRIAL ROBOTICS: Industrial Robots and their applications for transformational and handling activities. Configuration and motions, robot classification and their performance capabilities, hardware of robots, Actuators, sensors and end effectors, selecting assembly machines Feeding and transfer of arts, applications of robots in manufacture and assembly.

UNIT-V ADDITIVE MANUFACTURING: Introduction and Basic Principles of Additive Manufacturing, Development of Additive Manufacturing Technology, Generalized Additive Manufacturing Processess, Photopolymerization Processes / Powder based system Processes / Extrusion-Based Systems,

Material Jetting / Binder Jetting / Sheet Lamination/sintering Processes, Prototyping, Rapid Tooling, Applications of Additive Manufacturing, Comparison of Additive Manufacturing Methods.

Course Outcomes: After successful completion of this course students will be able to:

CO1 Illustrate the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion.

CO2 Demonstrate the machining operations, programming languages and its control system used for solving practical problems of automation based

CO3 Compare the components of computer integrated manufacturing and integrate them in a coordinated manner.

CO4 Decide between the various trade-offs when selecting AM processes, devices and materials to suit particular engineering requirements.

CO5 Designing Flexible manufacturing cell after carrying out Group technology study, Automated Material Handling Systems, Automated Inspection Systems and finally creating FMS.

CO6 Knowledge in the broad spectrum of Production Engineering.

Text & References Books:

1. Automation, Production system and computer integrated manufacturing by M.P. Groover, PHI publication.
2. CAD/CAM by P. N. Rao, P. N. Rao, Tata McGraw Hill publication
3. Computer control of machine tools by Koren Yoram, Tata McGraw Hill publication
4. Manufacturing Engineering And Technology by Serope Kalpakjian, PHI publication.
5. CAD/CAM/CIM by Bhupendra Gupta, Dhanpat Rai publication
6. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009.
7. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005.

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120611: Vibration and Noise Engineering

Category	Title	Code	Credit - 2			Theory Paper
Departmental Elective-DE1	Vibration and Noise Engineering	120611	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	-	

Prerequisite:

Engineering Mathematics, Basics of Electrical and Electronics, Theory of Machines, Mechanics of Materials

Course Objectives:

1. To understand the fundamentals of Vibration Theory.
2. To be able to mathematically model real-world mechanical vibration problems.
3. To be able to resolve industrial problems related to vibration and noise.

Syllabus

Unit-I: Basics of Vibration: Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition, beats phenomena, undamped and damped vibrations, free and forced vibration**,** Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations using Newton's second law, D' Alembert's principle and Principle of conservation of energy.

Unit-II: Multi Degree Freedom System: Free Vibration equation of motion. Langranges Equations Matrix Method, Eigenvalues and Eigenvector problems.Modal Analysis.Forced Vibrations of undamped system and modal analysis.

Numerical Methods: Rayleigh`s Method, Rayleigh-Ritz Method, Holzer`s Method, Methods of Matrix iterations, Transfer Matrix Method, Impulse response and frequency response functions.

UNIT III Continuous System:

Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous systems.

Transient vibrations: Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response functions.

Vibration Control:

Balancing of rotating machine, In-situ balancing of rotors, control of natural frequency, introduction of damping, transmissibility, vibration isolation & vibration absorbers.

UNIT IV Vibration Measurement:

Transducers, FFT analyzer, vibration exciters, signal analysis. Time domain & Frequency domain analysis of signals.Experimental modal analysis, Machine Conditioning and Monitoring, fault diagnosis.

UNIT V Noise and Its Measurement:

Sound waves, governing equation its propagation**,** Fundamentals of Noise, Decibel, Sound Pressure level, Sound Intensity, Sound fields, reflection, absorption and transmission. Noise measurement, Sound meter, Allowed exposure levels and time limit by B.I.S., Octave Band analysis of sound, Fundamentals of Noise control, source control, path control, enclosures, noise absorbers, noise control at receiver.

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Course Outcomes: After completing this course students are able to:

CO1: **understand** basics of vibration and noise.
CO2: **define** the physical systems in to spring-mass-damper systems.
CO3: **use** different methods and principles applicable to dynamic systems.
CO4: **determine** responses of vibrating systems.
CO5: **analyse** the behaviours of physical systems.
CO6: **design** the mechanical systems by considering vibration and noise.

Text Books:

1. Mechanical Vibrations: G K Groover.

References Books:

1. Theory of Vibrations with Applications: W T Thomson CBS Publishers Delhi
2. Mechanical Vibrations: S SRao Addison-Wesley Publishing Co.
3. Fundamentals of Vibration: Leonard Meirovitch , McGraw Hill International Edison.
4. Principles of Vibration Control: Asok Kumar Mallik, Affiliated East-West Press.
5. Mechanical Vibrations A H Church ,John Wiley & Sons Inc
6. Mechanical Vibrations J P Den Hartog ,McGraw Hill.
7. Mechanical Vibration Analysis: Srinivasan ,McGraw Hill.
8. Vibration and Noise for Engineers: KewalPujara ,DhanpatRai& CO.

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120612: Statistical Quality Control

Category	Title	Code	Credit-2			Theory Paper
Departmental Elective-DE1	Statistical Quality Control	120612	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	-	

Course Objective: To make the students to understand:

1. The concepts of inspection techniques.
2. About reliability, life testing and costing of product.

Syllabus

Unit-I: Statistical Concepts:

Inspection types, Organization, Advantages & Limitations. Comparison with quality control. Development. Statistical Concept-Frequency, Tally Sheet, Histogram, Bar Chart, Mean, Median, Mode, Standard Deviation. Variance. Concept of Probability, Hyper, Geometrical, Binomial, Poison & Normal Distribution, Area Under Normal Curve, Estimation of Parameters.

Unit-II: Control Chart Techniques:

Control Charts for Average, range & Standard Deviation, Fraction Defective & Percent Defectives, Control Chart for No. of Defects Per Unit.

Unit-III: Acceptance Sampling:

Fundamentals, OC Curves, Single Sampling Plan, Double Sampling plan, Sequential Sampling Plan. AQL & AOQL. Dodge – Roming Plan for Lot by Lot Acceptance Sampling for Attributes.

Unit-IV: Reliability, Cost & Design Aspects of S.Q.C.:

Life Testing & Reliability, Cost due to Poor Quality, Quality Cost With- 100% inspection, Sampling Inspection & NO. Inspection. Statistical Aspect of Tolerance Setting Design.

Unit-V: Quality Assurance:

Quality planning, Customer Satisfaction, History of Quality of Design, Quality of Conformance, Contribution of Juran, Demming Crosby, Ishikawa, Taguchi, Feighbaum, Quality Environment. 5-S, Vendor Rating, Quality in Purchasing, Quality After Sales Services, Quality of Performance, Human Resources. ISO Quality Standards-History, Need & Evaluation of Common Quality Standards. Product V/S System Quality. ISO 9000 Series of Standards & its Revisions. Management Participation, Quality Policy, Quality manual, Training Manual for Certification Bodies NACCB (UK), RVC (Netherlands), RAB(ASQC) USA, BIS. Certification Procedure, Quality Audit, Lead Assessors. ISO-14000 Standards. Limitations & Advantage for ISO Standards.

Course Outcomes: After successful completion of this course students will be able to:

CO1: Draw the histogram, bar charts.

CO2:**State** various techniques including various variable and attribute control charts

CO3: Relate mathematical standard plots for defect analysis.

CO4: Justify the life cycle of component on the basis of Reliability and Quality.

CO5: Compare various statistical quality control tools.

CO6: Solve quality-related problems using these SQC tools and methods.

Text books:

1. Grant, Statistical Quality Control, McGraw Hill, New York.
2. Mahajan and Mahajan , Statistical Quality Control Laxmi publication

Reference books:

1. M. Jeya Chandra ,Statistical Quality Control by, CRC Press

2. Douglas C. Montgomery ,Statistical Quality Control, John Wiley & Sons
3. Amitava Mitra, Fundamentals of Quality Control and Improvement , John Wiley & Sons

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120613 : Work Study and Ergonomics

Category	Title	Code	Credit-2			Theory Paper
Departmental Elective-DE1	Work Study and Ergonomics	120613/190612	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	-	

Course Objective: To make the students to understand:

1. Concept and significance of work study and ergonomics.
2. Various techniques of work-study for improving the productivity of an organization.

Syllabus

Unit -I Human being in Man Made World, Gross Human Anatomy, Anthropometrics, Static and Dynamic, Muscles and Work Physiology, Static and Dynamic Work including Maximum Capacity.

Unit-II Biomechanics, Environmental Condition including Thermal, Illumination Noise and Vibration, Biological Transducer and Nervous system including their Limitations. Control and Displays Psycho Physiological aspects of Design. Research Techniques in Ergonomics .Generation. Interpretation and application as statistical Methods. Case Analysis

Unit-III Method Study: - Selection of Problem, Application of critical examination techniques. Preparation of work Study Reports, Development of improved methods, preparation for and presentation of improved methods, implementation of improved methods, follow-up techniques and report.

Unit-IV Work Measurement: - Work Sampling. Fundamental statistical concepts sample size, procedure for making a work sampling study, determining time standards by work sampling, practical applications, advantages and disadvantages.

Unit-V Micro Motion Study:- PMTS. MTM Systems work factor system and Production Incentives

Course Outcome: After successful completion of this course students will be able to:

CO1. Identify potential and current OH&S hazards in the workplace relating to ergonomics issue.

CO2. Describe relation between human motion and industry.

CO3. Calculate the production capacity of man power of an organization.

CO4. Analyze the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.

CO5. Devise appropriate wage and incentive plan for the employees of an organization.

CO6. Design physical and psychosocial work system and work places.

Text & References Books:

1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
2. Lakhwinder Pal Singh, “Work Study and Ergonomics” CAMBRIDGE , 2010.
3. S.K. Sharma Savita Sharma , “Work Study and Ergonomics” S K Kataria and Sons 2006.
4. P.C.Tiwari, “Work Study and Ergonomics” CRC Press , 2004.
5. Suresh Dalela and Saurabh Dalela, “Work Study and Ergonomics” CRC Press , 2001.
6. Marvin E, Mundel & David L, "Motion & Time Study: Improving Productivity", Pearson Education,2000.
7. Benjamin E Niebel and Freivalds Andris, "Methods Standards & Work Design", Mc Graw Hill, 1997.
8. Work Study-Shan

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120614: Turbo Machinery

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Departmental Elective –DE1	Turbo Machinery	120614	2	-	-	Max.Marks-70 Min.Marks-22 Duration-3hrs

Course Objectives: To make the students to understand:

1. To enable the students know the operation of turbo machines for compressible and incompressible fluids.
2. To provide students thorough understanding of velocity triangles, thermodynamic plots and losses in turbo machinery.

Syllabus:

UNIT-I Fundamentals Of Turbo Machinery:

Energy Transfer in Turbo Machines Application of first and second Laws thermodynamics to turbo machines. Moment of momentum equation and Euler turbine equation.Principles of Impulse and reaction machines, degree of reaction, Energy equation for relative velocities, one dimensional analysis only.

UNIT-II Steam Turbine:

Impulse staging, velocity and pressure compounding utilization factor, analysis for optimum U.F. curtis stage, and Rateau stage, including qualitative analysis. Effect of blade and nozzle losses on Vane efficiency, Stage efficiency. Analysis for optimum efficiency vortex types of flow, flow with constant reaction. Governing and Performance characteristics of steam turbines.

UNIT-III Water Turbines:

Classification, Pelton, Francis and Kaplan turbines, vector diagrams and workdone, Draft Tubes, governing or water turbines, cavitation problem, methods to avoid cavitation, performance characteristics of water turbine.

UNIT-IV Centrifugal Pumps:

Classification, advantage over reciprocation type, definition of manometric head gross head, static head, vector diagram and work done. Performance and Characteristics: Application of dimensional analysis and similarity to water turbine and centrifugal pumps, unit and specific quantities, selection of machines, Hydraulic, volumetric mechanical and overall efficiencies, Main and operating characteristics of the machine cavitation.

UNIT-V Rotary Fans, Blowers and Compressors:

Classification based on pressure rise, Centrifugal and axial flow machines.

Centrifugal Blowers: Vane shapes, Velocity triangle degree of reactions, slip cost event speed of machine. Vane shape and stresses, efficiency characteristics. Fan laws and characteristics.

Centrifugal compressor : Vector diagrams, work done, temp, and pressure ratio, slip factor , was input factor, pressure coefficient, Dimensions of inlet eye, impeller and diffuser.

Axial flow compressors: Vector diagrams, work done factor, temp. and pressure ratio, degree reaction. Dimensional Analysis, Characteristics, surging, Polytropic and isentropic efficiencies.

Course Outcomes: After successful completion of this course students will be able to:

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CO1: Understand the working principles of rotating machines.

CO2: Describe the velocity triangles, thermodynamic plots and losses in turbo-machinery.

CO3: demonstrate the knowledge of working, stages, performance characteristics, governing and selection of turbo machinery.

CO4: analyze energy transfer through graphical and analytical methods in turbo machines.

CO5: design different type of rotating machines

CO6: evaluate the performance characteristics of different kinds of turbo machines

Text Books:

1. Fluid mechanics and fluid power engineering – by Dr. D. S. Kumar, Kat Son, Latest edition
2. Thermal Engineering – by P L Ballaney, Khanna Publisher Latest edition.

Reference Books:

1. Thermal Engineering-by R.K. Rajput, Latest edition
2. Turbines, Fans & Compressors – by S.M. Yahya, TMH Latest edition
3. Fluid Mechanics, Thermodynamics of Turbomachinery, S. L. Dixon, Butterworth-Heinemann, Latest edition
4. Power plant engineering, P K Nag TMH, Reprint Latest edition

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120651- Power Plant Engineering

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Departmental Elective-DE 2	Power Plant Engineering	120651	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_me10/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
January 27, 2020	March 20, 2020	March 29, 2020	8 Weeks

COURSE LAYOUT (Syllabus):

Week 1 : The energy scenario, steam power plants, fuel handling, ash handling, chimney draught

Week 2 : Fossil fuel steam generators, high pressure boilers, performance of boilers, fuels and combustion, steam turbines

Week 3 : Impulse turbines, reaction turbines, feed water treatment, steam condensers, problem solving

Week 4 : Condensate feed water system, circulating water system, gas turbine cycles, combined cycles, hydro-electric, power plants

Week 5 : Classification of hydro-plants , hydraulic turbines, hydro plant controls, problem solving

Week 6 : Principles of nuclear energy, thermal fission reactors and Power Plants, Fast breeder reactors, solar energy, solar thermal energy

Week 7 : Solar thermal energy, direct energy conversion, wind energy, geothermal energy, energy from oceans

Week 8 : Energy storage, economics of power generation, economics of power generation, environmental aspect of power generation, problem solving

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120652 Fundamental of welding science and Technology

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Departmental Elective-DE 2	Fundamental of welding science and Technology	120652	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_me23/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
January 27, 2020	March 20, 2020	March 29, 2020	8 Weeks

COURSE LAYOUT (**Syllabus):**

Week 1 : Introduction and classification of welding

Week 2 : Nomenclature and symbol of welding joints

Week 3 : Power source of welding

Week 4 : Physics and principle of arc welding

Week 5 : Different type of welding methods and their details

Week 6 : Different type of welding methods their details

Week 7 : Different type of welding methods their details

Week 8 : Welding defects and inspection

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120653 Gear And Gear Unit Design : Theory And Practice

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Departmental Elective-DE 2	Gear And Gear Unit Design : Theory And Practice	120653	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_me18/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24/Feb/20	17/Apr/20	25-Apr-20	8 Weeks

COURSE LAYOUT (**Syllabus):**

Week 1: Introduction to Gear and Gear unit Design

Week 2: Design of Spur (Straight and Helical), Bevel and Worm gears.

Week 3: Design of a gear box- part-1

Week 4: Design of a gear box- part-2

Week 5: Design of a gear box- part-3

Week 6: Design of a gear box- part-4

Week 7: Introduction to Involute Gear Tooth Correction

Week 8: Internal Gearing, Epicyclic and other special Gearing

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900101 (OC-1): Robotics

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Open Course-OC	Robotics	900101	2	-	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. Study and understand the concepts of robotics and mechatronics.
2. Impart basic knowledge about the different sensors and their applications in robotics.
3. Learn the basic fundamentals of actuation Systems.
4. To impart knowledge on the basic concepts of measurement, static and dynamic characteristics of measurement systems.
5. To work professionally in the area of robot programming.

Syllabus

UNIT - I Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system, Chain type: Serial manipulator and Parallel Manipulator. Components of Industrial robotics-recession of movement-resolution, accuracy and repeatability

Kinematic and Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors, Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, Force or Torque sensors.

UNIT - II Grippers - Mechanical Gripper-Grasping force, Magnetic gripper, vaccume cup gripper-considerations in gripper selection and design, **Industrial robots** specifications. Selection based on the Application.

UNIT – III Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix. Direct and Inverse Kinematics for industrial robots. Differential Kinematics for planar serial robots. **Dynamics**: Equations of motion, State-Space equation,

UNIT - IV Trajectory planning: Joint space scheme- Cubic polynomial fit, Obstacle avoidance in operation space-cubic polynomial fit with via point, Introduction Cartesian space scheme. Control- Interaction control, Rigid Body mechanics, **Control architecture**- position, path velocity, and force control systems, computed torque control, adaptive control, and Servo system for robot control.

UNIT – V Basics of data acquisition systems, Programming of Robots - programming methods (Arduino MATLAB, Bond Graph, etc.), Vision System, Bioinspired robots and applications, Teach pendent- overview of various textual programming languages, Application of knowledge.

Course Outcomes: After successful completion of this course students will be able to:

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CO1. Understand importance of robotics and its impact on human safety, quality of life,economy, environment, etc.; basics of open-ended type of Robotic manipulators.

CO2. Discuss Kinematics and dynamics of open ended robotic mechanisms; Fixing frames

CO3. Ability to formulate, derive, analyse, design and synthesize kinematics and dynamics of open ended robotic mechanisms.

CO4. Apply detailed concepts relating to various actuators, sensors, and theirintegration with drives and signal conditioning for robotics

CO5. Impart knowledge on the basic concepts of measurement, static and dynamic characteristics of measurement systems. control theory and applying them to design and development of robots

Text & References Books:

1. Introduction to Robotics: Mechanics and Control, **by** John J. Craig, Addison-Wesley.
2. Introduction to Robotics **by** S. K. Saha, Tata McGraw-Hill Publishing Company Ltd.
3. Introduction to Robotics Analysis Systems, Applications **by** S. B. Niku of Pearson Education.
4. Industrial Robotics-Technology Programming and Applications **by** M. P. Groover, M. Weiss, R. N. Nagel and N. G. Odrey of McGraw-Hill Book and Company
5. Robotics: Fundamental Concepts and Analysis **by** A. Ghosal of Oxford University Press.
6. Robot Dynamics and Control, **by**Spong M. W., and Vidyasagar M., John Wiley & Sons.
7. Mechatronic Systems: Fundamentals **by** R. Iserman ofSpringer.
8. Fundamentals of Mechatronics **by** Musa Jouaneh of Cengage Learning.
9. Mechatronics **by**W.Bolton, Pearson education.
10. Micromechatronics, Modeling, Analysis, and Design with MATLAB **by** V. Giurgiutiu and S. E. Lyshevski, CRC Press.
11. Bond Graph in Modeling, Amalendu**by** Mukherjee, RanjitKarmakar and Arun Kumar Samantaray, Simulation and Fault Identification, I. K. International Publishing House Pvt.

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900102 (OC-1): Product Design

Category	Title	Code	Credit - 2			Theory Paper
Open Course-OC	Product Design	900102	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	-	

Course Objective:

The goal of the course is to give an introduction to multidisciplinary aspects of product development and innovation. Students will familiarize themselves with basic methodology and tools that can be used in product development projects. Practical problems will be considered in cooperation with companies in order to simulate real product development situations.

SYLLABUS

Unit 1:

Basic: Significance of product design, product characteristics, product design and development process, the challenges of product development, design morphology, sequential engineering design method**.**

Product Planning: Identifying opportunities evaluate and prioritize projects, allocation of resources.

Unit 2:

Identifying Customer Needs: Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs, Translating customer needs

Product Specifications: Establish target specifications, setting final specifications, product costing.

Unit 3:

Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output.

Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, design for manufacturing, design for assembly, and design for maintenance, design for environment.

Unit 4:

Concept Selection: Overview, concept screening and concept scoring, methods of selection, Creativity techniques.

Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, general theory of innovation and TRIZ, Value engineering applications in product development and design, Model-based technology for generating innovative ideas.

Unit 5:

Concept Testing: Elements of testing: qualitative and quantitative methods including survey, measurement of customer's response.

Intellectual Property: Elements and outline, patenting procedures, claim procedure.

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Course Outcome: - After the completion of the course the student will be able to

CO1. **Analyze** the demands and needs of customers to conceptualize product.
CO2. **Describe** the different steps involved in the product design.
CO3. **Analyze** the shortcoming in the product development.
CO4. **Identify** the opportunities to develop the product.
CO5. **Utilize** the recourses available in efficient manner for maximum productivity.
CO6. **Forecast** the impact of product on the surrounding environment.

Text books and References:

1. Ulrich K. T, and Eppinger S.D, Product Design and Development, Tata McGraw Hill.
2. Otto K, and Wood K, Product Design, Pearson.
3. George Dieter, Engineering Design, MGH New York.
4. Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.
5. Inventive thinking through TRIZ: a practical guide, By Michael A. Orloff, Springer**.**
6. Systematic innovation: an introduction to TRIZ ; (theory of inventive Problem Solving), By John Terninko, AllaZusman, CRC Press.

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120711: Refrigeration and Air-conditioning

Category	Title	Code	Credit-2			Theory Paper
			L	T	P	
Departmental Elective –DE3	Refrigeration and Air-conditioning	120711	2	-	-	Max.Marks-70 Min.Marks-22 Duration-3hrs

Course Objectives: To make the students to understand

1. The fundamental principles and different methods of refrigeration and air conditioning.
2. Different refrigerants with respect to properties, applications and environmental issues.
3. The various equipment, operating principles, operating and safety controls employed in refrigeration air conditioning systems.

Pre-requisite: Engineering Thermodynamics

Syllabus

Unit I: Introduction to Refrigeration: –Basic Definition, ASHRAE Nomenclature, Air Refrigeration: Air Refrigeration Cycles-reversed Carnot cycle, Bell-Coleman cycle analysis, Air Refrigeration systems-merits and demerits, analysis.

Unit II: Vapour Compression Refrigeration System(VCRS): Carnot Vapour compression refrigeration cycle, Working and analysis, Limitations, Standard Vapour Compression Refrigeration system, Working and analysis, Effects of sub cooling and super heating, Multi-Pressure or Compound Vapour Compression Refrigeration Systems, Flash Gas removal, Flash inter cooling and water inter cooling.
Refrigerants: Classification, Selection of Refrigerants and Nomenclature of refrigerants, Desirable Properties of an ideal refrigerant, A discussion on Ozone layer Depletion and Global Warming.

Unit III: Vapour Absorption Systems: Absorbent – Refrigerant combinations, Water-Ammonia Systems, Water Lithium Bromide System, Contrast between the two systems, Modified Version of Aqua-Ammonia Brief Discussion on (i) Steam-Jet refrigeration system and (ii) Thermoelectric refrigeration system
Refrigeration System Equipment – Compressors, Condensers, Expansion Devices and Evaporators, System with Rectifier and Analyser Assembly

Unit IV: Psychrometry: Introduction to Air-Conditioning, Basic Definition, Classification, ASHRAE Nomenclature pertaining to Air-Conditioning, Applications of Air-Conditioning, Psychrometry –Air-water vapour mixtures, Psychrometric Properties, Psychrometric or Air-Conditioning processes, Psychrometric Chart.

Unit V: Air-Conditioning: Mathematical Analysis of Air-Conditioning Loads, Related Aspects, Numerical Problems, Different Air-Conditioning Systems-Central – Station Air-Conditioning System, Unitary Air-Conditioning System, Window Air-Conditioner and Packaged Air-Conditioner, Components related to Air-Conditioning Systems

Course outcomes: After the successful completion of this course, the student will be able to:

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1. **Understand** vapour compression refrigeration system.
2. **Describe** the working principles of air, vapour absorption, thermoelectric and steam-jet refrigeration systems.
3. **Obtain** cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems.
4. **Analyze** the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. **Develop** thermal comfort conditions with respect to temperature and humidity
6. **Estimate** cooling and heating loads in an air-conditioning system.

Text Books:

1. Arora C.P., Refrigeration and Air-conditioning, Tata McGraw –Hill Latest Edition, New Delhi

References Books :

1. Roy J. Dossat, Principles of Refrigeration, Wiley Limited
2. Stoecker W.F., and Jones J.W., Refrigeration and Air-conditioning, McGraw - Hill, New Delhi

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120712: Basic of Finite Element Analysis

Category	Title	Code	Credit - 2			Theory Paper
Departmental Elective-DE3	Basic of Finite Element Analysis	120712	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	-	

Course Objectives: To make the students to understand

1. The concepts of Mathematical Modelling of Engineering Problems.
2. The use of FEM to a range of Engineering Problems.

Prerequisite:

Engineering Mathematics, Mechanics of Materials, Machine Design

SYLLABUS

Unit-I Introduction: Historical Background, Mathematical Modelling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods, Variational Formulation of Boundary Value Problems – Ritz Technique , Basic concepts of the Finite Element Method.

Unit- II One-Dimensional Problems: One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements, Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer, Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

Unit- III Two Dimensional Scalar Variable Problems : Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements, Shape functions and element matrices and vectors, Application to Field Problems – Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

Unit- IV Two Dimensional Vector Variable Problems : Equations of elasticity – Plane stress, plane strain and axisymmetric problems, Body forces and temperature effects , Stress calculations , Plate and shell elements.

Unit- V Isoparametric Formulation : Natural co-ordinate systems, Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements, Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems –,Introduction to Analysis Software

Course Outcomes: After the successful completion of this course, the student will be able to:

1. **Understand** the basics of finite element formulation.

2. **Define** discrete and continuous models
3. **Use** variational Formulation of Boundary Value Problems
4. **Apply** finite element formulations to solve one dimensional Problem.
5. **Analyse** finite element formulations to solve 2D scalar Problems and vector problems
6. **Design** finite element method to solve problems on Isoparametric element and dynamic Problem

Text Books:

2. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005
3. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

References Books

1. C. S. Krishnamoorty, Finite Element Analysis, Tata McGraw-Hill
2. David V. Hutton, Fundamentals of Finite Element Analysis, McGraw Hill
3. Erik G. Thompson, Introduction to the Finite Element Method: Theory, Programming and Applications, John Wiley
4. H. C. Martin and G. F. Carey, Introduction to Finite Element Analysis - Theory and Application, NewYork, McGraw-Hill
5. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India, New Delhi, India
6. M. Mukhopadhyay, Matrix, Finite Element, Computer and Structural Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India
7. O. C. Zienkiewicz and Y. K. Cheung, The Finite Element Method in Structural and Soild Mechanics, McGraw Hill, London
8. R. D. Cook, Concepts and Applications of Finite Element Analysis, Wiley
9. S. S. Rao, Finite Element Analysis, Elsevier Butterworth-Heinemann

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120713: Metrology, Measurement and Control

Category	Title	Code	Credit-2			Theory Paper
Departmental Elective –DE3	Metrology, Measurement and Control	120713	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	-	

Course Objectives: To make the students to understand:

1. The types of errors, design of limit gauges and various comparative measurements.
2. The fundamentals of gears, thread measurements and measurements of surface finish.
3. Non-contact measurement techniques using optical methods and vision techniques.
4. Coordinate metrology and Form Measurement.
5. The use of control chart.

Prerequisite: Nil

Syllabus

Unit –I: General Concepts of Measurement; Definition-standards of measurement, errors in measurement, limit-gauging, various systems of limits, fits and tolerance, interchangeability, ISI and ISO system. basic principles and design of standards of measuring gauges, types of gauges and their design, accuracy and precision, calibration of instruments, principles of light interference, interferometer, measurement and calibration.

Unit –II: Linear and Angular Measurements; Slip gauges, micrometers, verniers, dial gauges, surface plates, comparators- mechanical, electrical, pneumatic and optical comparator, angular measuring instruments- sine bar, angle gauges, spirit level, autocollimators, clinometers; measurement of straightness, flatness and squareness.

Unit –III: Measurement of Surface Finish and Measuring Machines; Surface finish- definitions, types of surface texture, surface roughness measurement methods, comparison, profile-meters, pneumatic and replica, measurement of run out and concentricity, length bar measuring machine, optical projection, comparator, tool makers microscope.

Unit –IV: Metrology of Screw Threads and Gears; Internal/external screw thread, terminology, measurement of various elements of threads, thread micrometer method, two wire and three wire methods; gear terminology, measurement of various elements, constant chord method, base tangent method, plug method; gear tester, gear tooth measurement; rolling gear tester.

Unit –V: Computer Aided and Laser Metrology; Co-ordinate measuring machine; applications; laser micrometer, laser interferometer, laser scanning gauge, non contact and in- process inspection, vision system.

Course Outcomes: After successful completion of this course students will be able to:

1. **State** the basic of standards of measurement, limits, fits & tolerances.
2. **Compare** quality in engineering products.
3. **Apply** the principle of measurement in QC & QA aspects and calibration of measuring instruments.
4. **Analysis** the accuracy in the measurement.
5. **Evaluate** the product quality in manner of dimensional accuracy.
6. **Design** limit gauges.

Text & References Books:

1. Jain R.K.; Engineering metrology; Khanna publishers.
3. Gupta. I.C. “A text book of engineering metrology”, Dhanpat rai and sons.
4. Galye G.N et al; Metrology for engineers; elbs.
5. Rajput R.K; Engineering metrology and instrumentation; Kataria &sons publishers.

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120714: Total Quality Management

Category	Title	Code	Credit-2			Theory Paper
Departmental Elective –DE3	Total Quality Management	120714	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	-	-	

Course objectives: To make the student to understand:

1. The philosophy and core values of Total Quality Management (TQM).
2. How to evaluate best practices for the attainment of total quality.
3. The concept of ISO 9000 and quality manual.
4. The various methods of design and development to improve quality of product.
5. Impact of quality on economic performance and long-term business success of an organization.

Prerequisite: Nil

Syllabus

Unit - I Introduction: Introduction, Need for quality, Evolution of quality, Definitions of quality, Dimensions of product and service quality, Basic concepts of TQM, TQM Framework, Contributions of Deming, Juran and Crosby, Barriers to TQM, Quality statements, Customer focus, Customer orientation, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

Unit - II Principles: Leadership, Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal, Continuous process improvement, PDCA cycle, 5S, Kaizen, Kanban, Supplier partnership, Partnering, Supplier selection, Supplier Rating.

Unit - III Tools and Techniques: The seven traditional tools of quality, New management tools, Six sigma: Concepts, Methodology, applications to manufacturing, lean manufacturing, Agile manufacturing, Service sector including IT, Bench marking ,Reason to bench mark, Bench marking process, FMEA, Stages, Types.

Unit- IV Tools and Techniques: Control Charts, Process Capability, Concepts of Six Sigma, Quality Function Development (QFD), Taguchi quality loss function, TPM Concepts, improvement needs, Performance measures.

UNIT- V Quality Systems: Need for ISO 9000, ISO 9001-2008 Quality System, Elements, Documentation, Quality Auditing, QS 9000 – ISO 14000 – Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

Course outcomes: After successful completion of this course students will be able to:

1. **Discuss** about quality measures, Quality control techniques.
2. **Describe** various theories of Total quality management.
3. **Determine** the cost of poor quality and process effectiveness and efficiency to track performance quality.
4. **Apply** appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQM methodologies.
5. **Evaluate** the performance excellence of an organization, and determine the set of performance indicators

6. **Enhance** management processes, such as benchmarking and business process reengineering

Text & References Books:

1. TQM by Dr, K.C.Arora, S.K.Kataria and sons Publication, Delhi.
2. Jack Hiradsky TQM Hand book McGraw Hill New York
3. JH Taylor TQM Field Manual Me. Grew Hill Newyork
4. Chrisk Hakes: TQM-The key to business, Chapman and Holland.
5. Kim Todd, "World-class Performance", McGraw Hill, London
6. W J Sivanesan Production/Operations Management. Rich

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120751: Foundation of Computational Fluid Dynamics

Category	Title	Code	Credit – 2			Theory Paper
			L	T	P	
Departmental Elective-DE4	Foundation of Computational Fluid Dynamics	120751	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_me64/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
20-07-2020	11-09-2020	27-09-2020	8 Weeks

COURSE LAYOUT (Syllabus):

Week1

Module1: Introduction
Module 2: Review of basic fluid mechanics
Module 3: Review of equations and importance of terms
Module 4: Review of equations (contd.) and non-dimensionalization
Module 5: Vorticity-Stream function equation, classification of equation and the solution nature
Module 6: Classification of equations (contd.), types of boundary conditions and description about standard test cases.

Week2

Module 1: Steps involved in CFD, Information about Computational domain and grid with illustration
Module 2: Information about grid (contd.); Taylor's series expansion
Module 3: Taylor's series expansion, CD / FD / BD for first & second derivative;
Module 4: FD formula for non-uniform mesh; mixed derivative
Module 5: Derivation for higher derivative; FD formula by Polynomial procedure

Week3

Module 1: Different Approximation Methods
Module 2: Properties associated with discretization
Module 3: Errors due to approximation and their analysis – consistency, convergence
Module 4: Stability analysis
Module 5: FD formulation for model equations and explanation

Week 4

Module 1: FV formulation for diffusion equation – 1D
Module 2: Example and extension to 2D and 3D
Module 3: FV formulation for convection and diffusion equation
Module 4 & 5: Treatment of convective terms - different interpolations

Week 5

Module 1 & 2: Illustration on the performance by different approximation for convection terms
Module 3: Time integration methods
Module 4: Arrangement of variables; Introduction to Pressure velocity coupling, MAC
Module 5: SIMPLE
Module 6: Variants of SIMPLE, Projection Method

Week 6

Module 1: Introduction to Turbulent flows
Module 2: Deriving governing equations
Module 3: Reynolds stresses, modeling strategy

Module 4 & 5: Introduction to Standard models and explanation

Week 7

Module 1: Matrix inversion – Direct, Iterative procedure

Module 2: Direct solver / Iterative solver

Module 3 - 5: Iterative solver

Week 8

Module 1 - 5: Demonstration of a test case with a display of working CFD code and details

BOOKS AND REFERENCES

- Anderson, D.C., J.C, Tannehil, and R.H.Fletcher, Computational Fluid Mechanics, Hemisphere Publishing Corporation, NewYork.
- Ferziger, J.H. and M.Peric, Computational Methods for Fluid Dynamics, Springer, 3rd Edition, 2002
- Versteeg, H.K. and W.Malalasekera, An Introduction to Computational Fluid Dynamics – The Finite Volume method, Second Edition, 2007.
- Chung, T.J., Computational Fluid Dynamics, Cambridge University Press, 2002

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120752: Introduction to Composites

Category	**Title**	**Code**	**Credit - 2**			**Theory Paper**
Departmental Elective-DE 4	Introduction to Composites	120752	L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_me95/preview

The details of the course are mentioned below:-

Course Start Date	**Course End Date**	**Exam date**	**Enrollment Ends**	**Duration**
20 Jul 2020	09 Oct 2020	18 Oct 2020	27 Jul 2020	12 Weeks

COURSE LAYOUT (Syllabus):

Week 1: Intro and terminology
Week 2: Concept Review
Week 3: Fibers
Week 4: Matrix materials
Week 5: Short fiber composites
Week 6: Short fiber composites
Week 7: Orthotropic lamina
Week 8: Orthotropic lamina
Week 9: Orthotropic lamina
Week 10: Composite laminates
Week 11: Composite laminates
Week 12: Composite laminates

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120753: Advanced Machining Processes

Category	Title	Code	Credit – 2			Theory Paper
			L	T	P	
Departmental Elective-DE4	Advanced Machining Processes	120753	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_me76/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
17 Aug 2020	09 Oct 2020	18 Oct 2020	8 Weeks

COURSE LAYOUT (Syllabus):

Week 1 : Introduction to advanced machining processes and their classification
Week 1 : Ultrasonic machining and its modelling and analysis
Week 2 : Abrasive jet machining (AJM)
Week 2 : Water jet cutting (WJC) and Abrasive water jet machining (AWJM)
Week 2 : Magnetic abrasive finishing (MAF) and its modelling
Week 3 : Abrasive flow finishing (AFF) and its modelling
Week 3 : Magnetorheological finishing (MRF)
Week 4 : Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis
Week 5 : Electric discharge machining (EDM): Principle, applications, process parameters, and modelling
Week 5 : Electric Discharge Grinding (EDG), Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W-EDM)
Week 6 : Laser beam machining (LBM)
Week 6 : Plasma arc machining (PAM)
Week 6 : Electron Beam Machining (EBM)
Week 7 : Electro chemical machining (ECM): Principle, applications, and process parameters and modelling
Week 8 : Electrochemical Grinding (ECG), Electrostream Drilling (ESD), Shaped Tube Electrolytic Machining (STEM)
Week 8 : Chemical machining (ChM)

BOOKS AND REFERENCES

1. V. K. Jain, Advanced Machining Processes, Allied Publishers, 2009
2. Gary F. Benedict, Nontraditional Manufacturing Processes, Taylor & Francis, 1987
3. J. A. McGeough, Advanced Methods of Machining, Springer, 1988
4. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Prof Med/Tech, 2005
5. V. K. Jain, Introduction to Micromachining, Alpha Science International Limited, 2010

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120754: Industrial Safety Engineering

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Departmental Elective-DE 4	Industrial Safety Engineering	120754	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://swayam.gov.in/nd1_noc20_mg43/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
July 20, 2020	October 9, 2020	October 17, 2020	12 Weeks

COURSE LAYOUT

Week 1 : Introduction, key concepts, terminologies, and safety quantification, safety by design
Week 2 : Hazard identification techniques (e.g., HAZOP, FMEA, etc.)
Week 3 : Fault tree and event tree analysis (qualitative & quantitative)
Week 4 : Bow-tie and quantitative risk assessment (QRA)
Week 5 : Safety function deployment
Week 6 : Safety vs reliability – quantification of basic events (repair to failure, repair-failure-repair, and combined processes)
Week 7 : Safety vs reliability – quantification of basic events (contd.)
Week 8 : Systems safety quantification (e.g., truth tables, structure functions, minimal cut sets)
Week 9 : Human error analysis and safety
Week 10 : Accident investigation and analysis
Week 11 : Application of virtual reality
Week 12 : OSHAS 18001 and OSHMS

BOOKS AND REFERENCES

Probabilistic Risk Assessment for Engineering and Scientists, Komamoto and Henley, IEEE Press, 1995. Industrial Accident Prevention, Heinrich et al., McGraw Hill, 1980. Techniques for safety management - A systems approach, Petersen D, ASSE 1998.

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900203: INDUSTRIAL AUTOMATION

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC2	Industrial Automation	**900203**	2	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objective: To make the students to understand:

1. The basic principles and elements of automation.
2. The material handling and Identification Technologies.
3. The function of Industrial Robots and their applications for transformational and handling activities.

Pre-requisite: Nil

Syllabus

Unit I Introduction to Automation: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines.

Unit II Material handling and Identification Technologies: Overview of Material Handling Systems, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.

Unit III Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Quality Control Systems: Traditional and Modern Quality Control Methods, Inspection Principles and Practices, Inspection Technologies.

Unit IV Industrial Robotics: Industrial Robots and their applications for transformational and handling activities, Configuration and motions, robot classification and their performance capabilities, hardware of robots, Actuators, sensors and end effectors.

Unit V Overview of Industrial automation using robots: Selection and use of robots in manufacture and assembly, welding robot, machining inspection and painting.

Course Outcome: After the successful completion of this course, the student will be able to:

1. **Identify** potential areas for automation and justify need for automation
2. **Select** suitable major control components required to automate a process or an activity
3. **Translate** and simulate a real time activity using modern tools and discuss the benefits of automation.
4. **Decide** suitable automation hardware for the given application.
5. **Design** appropriate modeling and simulation tool for the given manufacturing application.

Text & References Books:

1. Automation, Production system and computer integrated manufacturing by M.P. Groover, PHI publication.
2. CAD/CAM by P. N. Rao, P. N. Rao, Tata McGraw Hill publication

3. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.
4. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.
5. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.

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900204: SOLAR ENERGY

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC2	Solar Energy	900204	2	1	-	Max. Marks – 70 Min. Marks – 22 Duration – 3 hrs

Course Objective: To make the students to understand:

1. The basic concepts of solar energy and various sun-earth angles.
2. How to develop thermal models and how to carry out economic analysis of solar systems and establish energy balance in different solar energy systems.
3. The different types of collectors, PV systems and their application.

Course Prerequisites: Basic Physics

Syllabus

UNIT – I Solar radiation, basic concepts, various Sun – Earth angles and modeling

UNIT – II Solar collectors and types: flat plate, concentrating solar collectors, Selective coatings, thermal modeling of flat plate collectors, applications of solar collectors.

UNIT – III Active and passive heating and cooling of buildings, Home lighting systems.

UNIT - IV Solar energy storage options, Solar Economics and life cycle cost analysis.

UNIT –V Solar photo voltaic System: Basic concepts of solar cell and PV Panel in series and parallel combination, characteristics curves of PV cell and panels, Photovoltaic materials, Need for different cell design, Applications of photovoltaic for power generation.

Course Outcomes: After successful completion of this course students will be able to:

1. **Define** the basic terms used in solar systems and various sun-earth angles.
2. **Establish** the energy balance and develop the thermal model of different solar systems.
3. **Investigate** the effectiveness of utilizing the solar energy by different solar systems.
4. **Analyze** the life cycle cost and other economic aspects of solar systems
5. **Describe** the application of solar systems and find out the areas of improvement.

Recommended Books:

1. Solar Energy by G.N. Tiwari
2. Solar Energy: Problems, Solution and Experiments by G.N. Tiwari, P. Barnwal, S.C. Solanki and M.K. Gaur
3. Solar Energy by John A. Duffie, William A. Beckman
4. Solar Energy by S.P. Sukhatme and J.K. Nayak

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900214: ENGINEERING MATERIALS FOR INDUSTRIAL APPLICATIONS

Category	Title	Code	Credit-3			Theory Paper
Open Course-OC3	Engineering Materials for Industrial Applications	**900214**	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	-	

Course Objectives: To make the students to understand:

1. The basic fundamentals of materials science and engineering.

937701024. The different classes of materials, their properties, structures and imperfections present in them.

937701025. The functional properties of materials and the roles of microstructure, heat treatment defects and environment play in typical engineering applications.

Course Prerequisites: Basic Chemistry

Syllabus

Unit- I Properties of Engineering Materials: Materials for space applications, Materials for Solar applications, Shape Memory Alloys, Materials for High Temperature Applications, Materials of Electronic and Electrical Applications: Semiconductors, Organic Semiconductors, Liquid Crystals, Electroluminescent Materials, Magnetic Materials. Materials for Development of Energy Efficient Building, Materials of Chemical Applications: Plastics, Rubber, Ceramics, Magneto-Rheological Materials

Unit-II Production of Engineering Materials: Production of Electronic Materials- Semiconductors, Magnetic Materials. Production of Civil Materials- Cements, Concrete, Steel and its types. Synthesis of Chemical Engineering Materials- Polymerisation, production of ceramics.

Unit- III Fabrication Techniques of Engineering Materials: Fabrication of ICs, optical fibres, steel, glass, ceramics, plastics.

Unit- IV Composite Materials: Introduction to composites, Particle- Reinforced Composites, Fibre-Reinforced Composites, Influence of Fibre Length and Orientation on properties, Different types of Fibre-Reinforced Composites, Structural Composites, fabrication process of Composites.

Unit - V Nano-materials and Super Alloys: Introduction to Nano technologies, nano-materials and their importance, Various methods of synthesis- Various kind of Nano-structures- Carbon fullerenes and CNT, Metal and metal oxide nano-wires, Self assembly of nano-structures, Core-shell nano-structures, Nano-composites. Physical and Chemical properties.

Super Alloys: Introduction to superalloys, Nickel- Iron Base Alloys, Cobalt- Base Alloys, Nickel- Base Alloys, Strengthening Mechanisms, Compositional Effects.

Course Outcomes: After successful completion of this course students will be able to:

1. **State** the properties of engineering materials.

2. **Understand** the material composition and their effects.
3. **Classify** different engineering material.
4. **Discuss** the production and fabrication techniques of Engineering Materials.
5. **Select** different types of materials as per requirement.

Text & Reference books:

1. Material Science and Engineering **by** Raghvan, V; Prentice Hall of India.
2. Material Science and Engineering by Callister's; Wiley Pub.
3. Elements of Material Science and Engineering **by** Lawrence, H. Vanvlack dison; Wesley.
4. Introduction to Engineering Materials **by** Agrawal, B.K; Tata Mc Graw Hill, N. Delhi.

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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Department of Mechanical Engineering

For batch admitted in Academic Session 2017-18

900215: Maintenance Engineering

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC3	Maintenance Engineering	**900215**	3	-	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objective: To make the students to understand:

1. The fault Identification, Computerized Maintenance Systems.
2. The Maintenance strategies and overall configuration and Maintenance of Machines , structure and System.
3. The Condition Monitoring & Non Destructive Testing.

Course Prerequisites: Basic Mathematics

Syllabus

Unit- I: Introduction, Maintenance Principles, FMECA, Fault Diagnostics and Prognostics, Machine Learning in CBM, Basics of Vibration, Free and Forced Response, Vibration and Shock Isolation, Practical Examples of Vibration.

Unit- II: Time Domain Analysis, Frequency Domain Analysis, Non Stationary Signal Analysis, Modulation and Beats, Orbit and Order Analysis, Computer aided data acquisition, Orbit and Order Analysis, Data Recording, Cepstrum Analysis, Hilbert Transform in Condition Monitoring.

Unit- III: Introduction to MATLAB, Signal Processing using MATLAB, Numericals in Signal Processing and Data Acquisition, Signal Hetrodyning, Practical Signals, Basics Of Instrumentation, Signal Conditioning and Filtering, Errors In Measurements, Dynamic Range And Frequency Response, Overview of Transducers For CBM.

Unit- IV: Accelerometers, Vibration Monitoring, Rotational Speed Measurements, Basics of Noise, Noise Monitoring, Introduction to Faults in Rotating Machines, Unbalance Detection, Field Balancing, Misalignment, Crack and Looseness, Journal and Anti-Friction Bearings, Gears, Pumps and Cavitation, IC Engines, machinery Diagnostic Chart, Principles of Motor Current Signature Analysis, Faults in Electrical Machines, Thermography, Wear Debris Analysis, Oil Analysis,

Unit- V: Non Destructive Testing, Ultrasonics, Eddy Current and Acoustic Emission, Radiography, Dye Penetrant Tests, Tool Condition Monitoring, Experimental Modal Analysis, Introduction to Failure Analysis, Railway Locomotive Noise and Vibration Monitoring, Paper Mill Vibration Monitoring, Overview of CBM facilities at SKF Reliability Lab, Future of Condition based Monitoring, Artificial Intelligence in Maintenance Engineering, Expert Systems for fault Diagnosis. IoT in Maintenance Engineering.

Course Outcomes: After successful completion of this course students will be able to:

1. **Describe** the fundamental concepts of maintenance engineering noise and vibration, measurement techniques of Condition Monitoring.
2. **Show** skills of fault diagnosis.
3. **Demonstrate** the need of instrumentation and signal processing for condition monitoring

4. **Examine** the condition of machine parts through Failure analysis of plant machineries
5. **Apply** correct usage of a method or procedure of maintenance.

Text & Reference books:

- A. R. Mohanty, Machinery Condition Monitoring: Principles and Practices, CRC Press, 2014
- Bikash Bhadury. 'Total Productive Maintenance". Allied Publisher Ltd. New Delhi.
- BC langlay. "Plant Maintenance". Prentice-Hall International. New Jersey.
- P Gopalakrishnan and AK Banerji, "Maintenance and Spare Parts Management". Prentice-Hall of India (P) Ltd. New Delhi.
- Kelly, "Maintenance Planning & Control"
- Industrial Maintenance by HP Garg. S. Chand & Company Ltd., New Delhi.
- Srivastava S.K., “Industrial Maintenance Management”, - S. Chand and Co., 1981
- Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 1995
- White E.N., “Maintenance Planning”, I Documentation, Gower Press, 1979.
- Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.
- Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill, 5th Edition, 1988.
- Armstrong, “Condition Monitoring”, BSIRSA, 1988.
- Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 1996.

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Department of Mechanical Engineering

Category	Title	Code	Credit - 2			Theory Paper
Departmental Elective-DE 5	Quality Design and Control	120851	L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_mg24/preview

The details of the course are mentioned below: -

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	09-04-2021	25-04-2021	12 Weeks

COURSE LAYOUT

Week 1: History and Evolution of Quality Control and Management

Week 2: Management of Quality-I

Week 3: Management of Quality-II

Week 4: Statistical Process Control-I

Week 5: Statistical Process Control-II

Week 6: Process Capability Analysis

Week 7: Acceptance Sampling-I

Week 8: Acceptance Sampling-II

Week 9: Design for Reliability-I

Week 10: Design for Reliability-II

Week 11: Quality by Experimental Design

Week 12: Robust Design and Taguchi Method

BOOKS AND REFERENCES

1. Mitra, A. Fundamentals of Quality Control and Improvement, Prentice-Hall, 2nd Edn .(1998), ISBN: 0-13-645086-5.

2. Dukkipati, R V and Pradip K Ray, Product and Process Design for Quality, Economy and Reliability, New Age International. 1st Edn. (2010), ISBN: 978-81-224-2661-8.

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Department of Mechanical Engineering

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Departmental Elective-DE 5	Robotics: Basics and Selected Advanced Concepts	120852	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_me37/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	09-04-2021	24-04-2021	12 Weeks

COURSE LAYOUT

Week 1: Introduction, Elements of a robot

Week 2: Mathematical preliminaries, D-H convention, Examples

Week 3: Direct and Inverse kinematics of serial robots, Workspace, Analytical and numerical solutions

Week 4: Parallel robots – direct and inverse kinematics, Mobility, Stewart-Gough platform

Week 5: Applications of parallel robots in sun tracking, vibration isolation

Week 6: Velocity analysis, Singularities in serial and parallel robots, Statics

Week 7: Redundancy and resolution of redundancy in robots

Week 8: Dynamic equations of motion, derivation & simulation using Matlab

Week 9: Motion planning, Introduction to linear control, simulations & experiments

Week 10: Nonlinear position and force control of robots, Simulations

Week 11: Wheeled mobile robots, modeling and simulations

Week 12: Over-constrained and deployable structures, Cable driven & pneumatically actuated flexible robots

BOOKS AND REFERENCES

Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2006
Recent research papers

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Department of Mechanical Engineering

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Departmental Elective-DE 5	Steam and Gas Power Systems	120853	2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_me21/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
15-02-2021	09-04-2021	25-04-2021	8 Weeks

COURSE LAYOUT

Week-1: Review of Thermodynamics, Rankine Cycle, Performance of Rankine Cycle, Binary Vapour Cycle and Co-generation, Problem Solving.

Week-2: Steam Generators, Fire Tube Boilers, Water Tube Boilers, Boiler Mountings and Accessories, High Pressure Boilers- LaMont and Benson Boilers.

Week-3: High Pressure Boilers- Loeffer and Velox Boilers, Draught, Performance of Boilers, Combustion of Fuel, Problem Solving.

Week-4: Boiler Trial, Nozzles and Diffusers-Momentum and Continuity Equations, Nozzles and Diffusers-Efficiency and Critical Pressure, Nozzles and Diffusers-General Relationship and supersaturated Flow, Problem Solving.

Week-5: Steam Turbines, Compounding of Steam Turbines, Impulse Steam Turbines, Impulse Steam Turbine Performance, Problem Solving.

Week-6: Impulse-Reaction Steam Turbines, Impulse-Reaction Turbine Performance, Energy Losses in Steam Turbines, Condensers, Problem Solving.

Week-7: Gas Turbine Cycles, Gas Turbine Cycles- Performance Evaluation, Gas Turbine Cycles-Modifications, Problem Solving, Centrifugal Compressors.

Week-8: Centrifugal Compressor Characteristics, Axial Flow Compressors, Axial Flow Compressor Characteristics, Jet Propulsion, Problem Solving.

BOOKS AND REFERENCES

Basic Engineering Thermodynamics, Rayner Joel, AWL

Roger Gordon & Yon Mayhew, Engineering Thermodynamics work and heat Transfer, Power Plant Engineering, P. K. Nag, TMGH

Power Station Engineering and Economy, Skrotzki, GA Vopat, WA TMGH

El-Wakil M.M., Power Plant Technology, MGH

An Introduction to Energy Conversion (Vol. 3)-Turbo machinery, Kadambi, Prasad M., Willy.

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Department of Mechanical Engineering

Category	Title	Code	Credit - 2			Theory Paper
Open Category-4	Waste to Energy Conversion		L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_ch09/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	12-03-2021	21-03-2021	8 Weeks

COURSE LAYOUT

Week 1 - Introduction, characterization of wastes.

Week 2 - Energy production form wastes through incineration, energy production through gasification of wastes.

Week 3 - Energy production through pyrolysis and gasification of wastes, syngas utilization.

Week 4 - Densification of solids, efficiency improvement of power plant and energy production from waste plastics.

Week 5 - Energy production from waste plastics, gas cleanup.

Week 6 - Energy production from organic wastes through anaerobic digestion and fermentation, introduction to microbial fuel cells.

Week 7 - Energy production from wastes through fermentation and transesterification.

Week 8 - Cultivation of algal biomass from wastewater and energy production from algae.

BOOKS AND REFERENCES

- Rogoff, M.J. and Screve, F., "Waste-to-Energy: Technologies and Project Implementation", Elsevier Store.
- Young G.C., "Municipal Solid Waste to Energy Conversion processes", John Wiley and Sons.
- Harker, J.H. and Backhusrt, J.R., "Fuel and Energy", Academic Press Inc.
- EL-Halwagi, M.M., "Biogas Technology- Transfer and Diffusion", Elsevier Applied Science.
- Hall, D.O. and Overeed, R.P.," Biomass - Renewable Energy", John Willy and Sons.
- Mondal, P. and Dalai, A.K. eds., 2017. *Sustainable Utilization of Natural Resources*. CRC Press.

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Department of Mechanical Engineering

Category	Title	Code	Credit - 2			Theory Paper
Open Category-4	Product Design and Manufacturing		L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: -https://onlinecourses.nptel.ac.in/noc21_me66/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	09-04-2021	24-04-2021	12 Weeks

COURSE LAYOUT

Week 1 : Introduction to product design and manufacturing
Week 2 : Product design morphology
Week 3 : Visual Design, and Quality Function Deployment (QFD)
Week 4 : Value Engineering
Week 5 : Material, and Manufacturing process selection
Week 6 : Design for Manufacturing, Assembly, and Maintenance
Week 7 : Design for Environment, and Quality Control
Week 8 : Patenting, and Creativity
Week 9 : Rapid Prototyping
Week 10 : Plant Layout Design
Week 11 : Computer Integrated Manufacturing
Week 12 : Reverse Engineering, and Managing Competitiveness

BOOKS AND REFERENCES

- Eppinger, S. and Ulrich, K., 2015. Product design and development. McGraw-Hill Higher Education
- Magrab, E.B., Gupta, S.K., McCluskey, F.P. and Sandborn, P., 2009. Integrated product and process design and development: the product realization process. CRC Press.
- Boothroyd, G., 1994. Product design for manufacture and assembly. Computer-Aided Design, 26(7), pp505-520.

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Department of Mechanical Engineering

Category	Title	Code	Credit - 2			Theory Paper
			L	T	P	
Open Category-4	Automatic Control		2	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: -https://onlinecourses.nptel.ac.in/noc21_me13/preview

The details of the course are mentioned below: -

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	12-03-2021	21-03-2021	12 Weeks

COURSE LAYOUT

Week 1: Automatic Control System.

Week 2: Mathematical Modelling.

Week 3: Transient Response Analysis.

Week 4: Stability and Steady State Error.

Week 5: Root Locus Technique.

Week 6: Design via Root Locus and Compensation Techniques.

Week 7: State Space Method.

Week 8: Application of MATLAB in Automatic Control.

BOOKS AND REFERENCES

- Nise, N.S., Control Systems Engineering, 5th Ed., Willey, 2008.
- Ogata, K., “Modern Control Engineering”, 5th Ed., Prentice Hall of India, 2013.
- Kuo, B.C., “Automatic Control System”, 5th Ed., Prentice Hall of India, 1995.
- Raven, F.H., “Automatic Control Theory”, 5th Ed., McGraw Hill, 1995.

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Department of Mechanical Engineering

Category	Title	Code	Credit - 2			Theory Paper
Open Category-5	Mechatronics		L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: -https://onlinecourses.nptel.ac.in/noc21_me27/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	12-03-2021	21-03-2021	12 Weeks

COURSE LAYOUT

Week 1: Introduction to mechatronics
Week 2: Electric Circuits and Semiconductor Electronics
Week 3: Sensors and transducers
Week 4: Actuators and mechanisms
Week 5: Signal conditioning
Week 6: Microprocessors and microcontrollers
Week 7: Modeling and system response
Week 8: Design and mechatronics

BOOKS AND REFERENCES

1. Mechatronics: Bolton, W., Longman/div>
2. Introduction to Mechatronics: D.G. Alciatore & Michael B. Histand; Tata Mc Graw Hill
3. Mechatronic system Design; Shetty Dedas, Kolk and Richard
4. Mechatronic handbook: Bishop; CRC press
5. Intelligent Mechatronic Systems: Modeling, Control and Diagnosis, R. Merzouki, A. K. Samantaray, P. M. Pathak, B. Ould Bouamama, Springer, London

Category	Title	Code	Credit - 2	Theory Paper

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Department of Mechanical Engineering

Open Category-5	Elements of Solar Energy Conversion		L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: -https://onlinecourses.nptel.ac.in/noc21_me34/preview

The details of the course are mentioned below: -

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	09-04-2021	25-04-2021	12 Weeks

COURSE LAYOUT

Week 1: Basic concepts related to solar radiation, the sun, spectral distribution, sun- earth relationship, extraterrestrial radiation, revolution of earth, seasons, position of sun in the sky, position of sun with respect to the center of the earth

Week 2: Concept of time, equation of time, solar time, standard time, Role of atmosphere on solar radiation, air mass, terrestrial spectrum, prediction of solar radiation

Week 3: Diffuse and direct radiation, derivation of the relationships between angles

Week 4: Sign conventions, angle of incidence on a tilted plane, shading, sun-path diagram, overhangs, parallel rows of solar collectors, measurement of radiation

Week 5: Estimation of total irradiance on a tilted surface, radiation augmentation

Week 6: Flat plate collector, thermal analysis, heat removal factor

Week 7: Air heaters, thermal analysis of air heaters, overview of other thermal collectors, testing procedure

Week 8: Single axis tracking, concentrating collectors, theoretical limit, classifications of concentrators

Week 9: Parabolic trough collector, thermal analysis, compound parabolic concentrators, parabolic dish collector, central receiver tower

Week 10: Non-thermal routes for solar energy conversion, Basics of photovoltaic effect, Electron-hole carrier formation and motion

Week 11: Band bending, photovoltaic generation, P-N junction diode, forward Bias, reverse bias

Week 12: Dark current, light-generated current, IV characteristic curve for P-N junction diodes, efficiency, effect of temperature intensity and spectrum, Comparative discussion on different solar conversion technologies in the state-of-the-art form and the future directions.

BOOKS AND REFERENCES

Solar Engineering of Thermal Processes, 4th Ed, Duffie and Beckman,Wiley
Solar Energy, 4th Ed, Sukhatme and Nayak, McGraw-Hill Education
Solar Photovoltaics, 3rd Ed, Solanki, PHI learning pvt. Ltd.
Solar Energy Engineering, 2nd Ed, Kalogirou, Academic Press
Solar Energy, 1st Revised ed, Garg- Prakash, McGraw-Hill Education

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Department of Mechanical Engineering

Category	Title	Code	Credit - 2			Theory Paper
Open Category-5	Traditional and Non-Traditional Optimization Tools		L	T	P	As per SWAYAM/NPTEL norms
			2	-	-	

SWAYAM/NPTEL Link for the course: - https://onlinecourses.nptel.ac.in/noc21_me58/preview

The details of the course are mentioned below: -

Course Start Date	Course End Date	Exam date	Duration
18-01-2021	12-03-2021	21-03-2021	8 Weeks

COURSE LAYOUT

Week 1: Principle of Optimization; Traditional Methods of Optimization; Binary-Coded Genetic Algorithm (BCGA)
Week 2: Binary-Coded Genetic Algorithm (BCGA) (contd.); Schema Theorem of BCGA; Constraints Handling; Real-Coded GA
Week 3: Faster Genetic Algorithms; Scheduling GA
Week 4: Scheduling GA (contd.); Simulated Annealing; Particle Swarm Optimization
Week 5: Multi-Objective Optimization; Intelligent Optimization Tool
Week 6: A Practical Optimization Problem solved using different Traditional and Non-Traditional Optimization Tools
Week 7: Solutions of a Practical Optimization Problem (contd.); Genetic Algorithm as Evolution Tool
Week 8: Genetic Algorithm as Evolution Tool (contd.); Summary of the Course

BOOKS AND REFERENCES

1. Soft Computing: Fundamentals and Applications by D.K. Pratihar, Narosa Publishing House, New-Delhi, 2015
2. Optimization by S.S. Rao, Theory and Applications, Wiley Eastern Limited, 1978
3. Optimization for Engineering Design by K. Deb, Prentice-Hall of India Private Limited, 1995
4. Genetic Algorithms in Search, Optimization and Machine Learning by D.E. Goldberg, Addison-Wesley, Reading, MA, 1989.