Bachelor of Engineering

(Mechanical Engineering)

Syllabus and Scheme

Valid for batches admitted in Academic Session 2015-2016

Department of Mechanical Engineering

Syllabus is dynamic, if you fail, the new syllabus will be applicable similarly to that for new students.

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A UGC-Autonomous Institute affiliated to RGPV, Bhopal)

COURSE CONTENT: MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

(*For batches admitted in Academic Session 2015-2016) w.e.f July 2015*

First B.E. Bachelor of Engineering in Mechanical Engineering

I SEMESTER

Bachelor of Engineering (Mechanical Engineering)													
I Semester			Theory			Practical			Hour/Week				
S.N	CODE	SUBJECT TITLE	End Sem	Mid Sem	Quiz, Assignment	End Sem	Lab Work	Quiz ,Assignment	Lecture	Tutorial	Practical	Total Credits	
1	BMEL101	Mathematics-I	60	30	10	0	0	0	3	1	0	4	
2	BMEL102	Chemistry	60	30	10	10	20	20	2	1	2	4	
3	BMEL103	English	60	30	10	10	20	20	3	0	2	4	
4	BMEL104	Engineering Mechanics	60	30	10	10	20	20	3	0	2	4	
5	BMEL105	Basic Computer Programming	60	30	10	10	20	20	2	1	2	4	
6	BMES106	Environmental Sciences	0	0	0	0	0	100	1	0	2	2	
7	BMES107	Introduction to Mechanical Engineering	0	0	0	0	0	100	0	0	4	2	
8	BMES108	Communication	0	0	0	0	0	100	0	2	0	2	Total Marks
		Total	**300**	**150**	**50**	**40**	**80**	**380**	**14**	**5**	**14**	**26**	**1000**

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First B.E. Bachelor of Engineering in Mechanical Engineering

II SEMESTER

Bachelor of Engineering (Mechanical Engineering)													
II Semester			**Theory**			**Practical**			**Hour/Week**				
S.N	**CODE**	**SUBJECT TITLE**	**End Sem**	**Mid Sem**	**Quiz, Assignment**	**End Sem**	**Lab Work**	**Quiz ,Assignment**	**Lecture**	**Tutorial**	**Practical**	**Total Credits**	
1	BMEL201	Mathematics-II	60	30	10	0	0	0	3	1	0	4	
2	BMEL202	Physics	60	30	10	10	20	20	2	1	2	4	
3	BMEL203	Fundamentals of Electrical Engineering	60	30	10	10	20	20	2	1	2	4	
4	BMEL204	Engineering Graphics	60	30	10	10	20	20	2	0	4	4	
5	BMEL205	Concepts in Engineering Design	60	30	10	0	0	0	2	1	0	3	
6	BMES206	Manufacturing Practices	0	0	0	0	50	50	1	0	2	2	
7	BMES207	Language Lab	0	0	0	0	50	50	0	0	4	2	
8	BMES208	Basic Mechanical Engineering Lab	0	0	0	0	0	150	0	0	6	3	Total Marks
		Total	**300**	**150**	**50**	**30**	**160**	**310**	**12**	**4**	**20**	**26**	**1000**

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First B.E. Bachelor of Engineering in Mechanical Engineering

III SEMESTER

Semester – III: B.E. (Mechanical Engineering)

S.NO.	Subject Code	Subject Name	Maximum Marks Allotted						Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot							
			End Sem.	Mid Sem.	Quiz/ Assignment	End Sem.	Lab Work	Assign ment		L	T	P	
1.	BMEL-301	Mathematics-III	70	20	10	-	-		100	3	1	-	4
2.	BMEL-302	Mechanics of Materials-I	70	20	10	30	10	10	150	2	1	2	4
3.	BMEL-303	Manufacturing Process	70	20	10	30	10	10	150	2	1	2	4
4.	BMEL-304	Thermodynamics	70	20	10	30	10	10	150	2	1	2	4
5.	BMEL-305	Material Science	70	20	10	-	-	-	100	3	1	-	4
6.	BMEP-306	Machine Drawing Lab	-	-	-	30	10	10	50	-	-	4	2
7.	BMES-307	Seminar/ Presentation/ GD	-	-	-	-	-	50	50	-	-	4	2
8.	BMES-308	Integrated Ethics and Attitude	-	-	-	-	-	50	50	-	-	4	2
9.		NSS/NCC	-	-	-	-	-	-	-	-	-	-	Qualifier
Total			**350**	**100**	**50**	**120**	**40**	**140**	**800**	**12**	**5**	**18**	**26**

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

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COURSE CONTENT: MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

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First B.E. Bachelor of Engineering in Mechanical Engineering

IV SEMESTER

Semester – IV: B.E. (Mechanical Engineering)

S.No.	Subject Code	Subject Name	Maximum Marks Allotted						Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot							
			End Sem.	Mid Sem.	Quiz/ Assignment	End Sem.	Lab Work	Assignment		L	T	P	
1.	BMEL-401	Machine Design-I	70	20	10	-	-	-	100	3	1	-	4
2.	BMEL-402	Metal Cutting and Machine Tools	70	20	10	30	10	10	150	2	1	2	4
3.	BMEL-403	Theory of Machine-I	70	20	10	30	10	10	150	2	1	2	4
4.	BMEL-404	Fluid Mechanics	70	20	10	30	10	10	150	2	1	2	4
5.	BMEL-405	Thermal Engineering	70	20	10	-	-	-	100	3	1	-	4
6.	BMEP-406	Departmental Lab/Simulation Lab	-	-	-	30	10	10	50	-	-	4	2
7.	BMES-407	Idea Generation	-	-	-	-	-	50	50	-	-	4	2
8.	BMES-408	Communication Skills	-	-	-	-	-	50	50	-	-	4	2
9.		NSS/NCC	-	-	-	-	-	-	-	-	-	-	Qualifier
Total			**350**	**100**	**50**	**120**	**40**	**140**	**800**	**12**	**5**	**18**	**26**

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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COURSE CONTENT: MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

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First B.E. Bachelor of Engineering in Mechanical Engineering

V SEMESTER

B.E. V Semester (Mechanical Engineering)

S.No.	Subject Code	Subject Name		Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem	Mid Sem	Quiz/Assignment	End Sem	Lab work & Sessional		L	T	P	
1.	**BMEL- 501**	**Elective-I***	**Metrology, Measurement and Control**	70	20	10	-	-	100	3	1	-	**4**
	BMEL - 502		**Aerospace propulsion**										
2.	**BMEL - 503**	**Advance Mechanics of Materials**		70	20	10	30	20	150	3	1	2	**5**
3.	**BMEL - 504**	**Industrial Engineering**		70	20	10	-	-	100	3	1	-	**4**
4.	**BMEL- 505**	**Internal Combustion Engine**		70	20	10	30	20	150	3	1	2	**5**
5.	**BMEL - 506**	**Machine Design-II**		70	20	10	30	20	150	3	1	2	**5**
6.	**BMEP - 507**	**Simulation Lab – II**		-	-	-	30	20	50	-	-	2	**1**
7.	**BMES - 508**	**Self Study (Internal Assessment)**		-	-	-	-	50	50	-	-	2	**1**
8.	**BMES - 509**	**Seminar & Group Discussion (Internal Assessment)**		-	-	-	-	50	50	-	-	2	**1**
Total				**350**	**100**	**50**	**120**	**180**	**800**	**15**	**5**	**12**	**26**

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

Elective-I*	Metrology, Measurement and Control	Aerospace propulsion	Composite Material	Additive Manufacturing

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COURSE CONTENT: MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

(*For batches admitted in Academic Session 2015-2016) w.e.f July 2017*

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VI SEMESTER

B.E. VI Semester (Mechanical Engineering)

S.No	Subject Code	Subject Name		Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem	Mid Sem	Quiz/ Assignment	End Sem	Lab work & Sessional		L	T	P	
1.	**BMEL- 601**	**Principles of Management & Managerial Economics**		70	20	10	-	-	100	3	1	-	**4**
2.	**BMEL- 602**	**Elective-II***	**Computer Integrated Manufacturing**	70	20	10	-	-	100	3	1	-	**4**
	BMEL- 603		**Power Plant Engineering**										
3.	**BMEL- 604**	**Operation Research & Supply Chain**		70	20	10	30	20	150	3	1	2	**5**
4.	**BMEL- 605**	**Turbo Machinery**		70	20	10	30	20	150	3	1	2	**5**
5.	**BMEL - 606**	**Dynamics of Machines**		70	20	10	30	20	150	3	1	2	**5**
6.	**BMEP -607**	**Minor Project**		-	-	-	30	20	50	-	-	2	**1**
7.	**BMES - 608**	**Self Study (Internal Assessment)**		-	-	-	-	50	50	-	-	2	**1**
8.	**BMES - 609**	**Seminar & Group Discussion (Internal Assessment)**		-	-	-	-	50	50	-	-	2	**1**
Total				**350**	**100**	**50**	**120**	**180**	**800**	**15**	**5**	**12**	**26**

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

Elective- II*	Computer Integrated Manufacturing	Power Plant Engineering	Unconventional Machining Process	Fracture Mechanics

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Choice Based Credit System (CBCS)

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First B.E. Bachelor of Engineering in Mechanical Engineering

VII SEMESTER

B.E. VII Semester (Mechanical Engineering)

S. No.	Subject Code	Subject Name & Title		Maximum Marks Allotted						Contact Periods per week			Total credits	Remarks
				Theory Slot			Practical Slot		Total Marks	L	T	P		
				End Sem.	Mid Sem	Quiz Assignment	End Sem.	Lab Work & Sessional						
1.	BMEL -701	Machine Design-III		70	20	10	30	20	150	3	1	2	5	
2.	BMEL -702	Refrigeration & Air- Conditioning		70	20	10	30	20	150	3	1	2	5	
3.	BMEL -703	Robotics & Mechatronics		70	20	10	--	--	100	3	1	--	4	
4.	BMEL-704	Heat & Mass Transfer		70	20	10	30	20	150	3	1	2	5	
5.	BMEL -705	Elective-III	(i) Production & Operation & Management	70	20	10	--	--	100	3	1	--	4	
			(ii) Gas Dynamics											
			(iii) Material Handling systems and Equipment											
			(iv) Non-conventional energy sources											
			(v) Machine Tool Technology											
6.	BMET -706	Industrial Training		--	--	--	--	50	50	-	-	2	1	
7.	BMED - 707	Project-I		--	--	--	60	40	100	-	-	4	2	Grand Total
Total				350	100	50	150	150	800	15	5	12	26	800

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COURSE CONTENT: MECHANICAL ENGINEERING

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

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COURSE CONTENT: MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

(*For batches admitted in Academic Session 2015-2016) w.e.f July 2018*

First B.E. Bachelor of Engineering in Mechanical Engineering

VIII SEMESTER

B.E. VIII Semester (Mechanical Engineering)

S. No.	Subject Code	Subject Name & Title	Maximum Marks Allotted						Credit Allotted Subject wise			Total credits	Remarks
			Theory Slot			Practical Slot		Total Marks	Period per week				
									L	T	P		
			End Sem.	Mid Sem	Quiz/ Assignment	End Sem.	Lab Work & Sessional						
1.	BMEL - 801	Vibration & Noise Control	70	20	10	30	20	150	3	1	2	5	
2.	BMEL - 802	Automobile Engineering	70	20	10	30	20	150	3	1	2	5	
3.	BMEL - 803	Statistical Quality Control/Statistical Process Control	70	20	10	30	20	150	3	1	2	5	
4.	BMEL - 804	Elective - IV: (i) Emerging Technologies & Management Techniques	70	20	10	--	--	100	3	1	--	4	
		Elective - IV: (ii) Advance Welding Technology											
		Elective - IV: (iii) Optimization Techniques											
		Elective - IV: (iv) Maintenance Engineering											
		Elective - IV: (v) Project Management											
5.	BMES -805	Seminar/Self Study	--	--	--	--	50	50	--	--	2	1	Grand Total
6.	BMED -806	Project-II	--	--	--	120	80	200	--	--	8	4	
Total			280	80	40	210	190	800	12	04	16	24	800

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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COURSE CONTENT: MECHANICAL ENGINEERING

100105: Engineering Graphics

Category	Title	Code	Credit-6			Theory Paper
			L	T	P	
Departmental Core - DC	Engineering Graphics	100105	4	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives:

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 - I

Introduction: Instruments, lettering and dimensioning, plane geometrical constructions.

Scales: Plain and Diagonal scale – representative factor, 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 on the curves. Spiral curves - Archimedean and logarithmic spiral curves. Tangent and normal on the curves. Involute curve.

Unit - II Orthographic projection

Projections of points: Introduction, types of projections, quadrant system, positions of points, exercise.

Projection of straight line: Introduction, orientation of a straight line, traces of a line and exercise.

Unit - III

Projection of planes: Introduction, types of planes, traces of planes, position of planes, exercise.

Projection of solids: Introduction, types of solids, positions of solids and exercise.

Unit - IV

Section of solids: introduction, types of section planes and anti-section and exercise.

Development of surfaces of right solids: Introduction, methods of development, and anti-development.

Unit - V

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

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

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

1. **Imagine** and visualize the geometric details of engineering objects.
2. **Translate** the geometric information of engineering objects into engineering drawings.
3. **Use** computer aided drafting in their respective engineering field.
4. **Develop** knowledge to read, understand and explanation of drawing.
5. **Improve** their skills so that they can apply these skills in developing new products.
6. **Prepare** simple layout of factory, machine and buildings.

Text & References 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 Basant Agrawal & C. M. Agrawal, Tata McGraw Hill Education Pvt. Ltd.
4. Engineering Graphics by K. Venugopal, New Age International Publication, India

Laboratory Work

Sketching and Drawing of geometries and projections based on above syllabus.

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COURSE CONTENT: MECHANICAL ENGINEERING

100106: Manufacturing Practices

Category	Title	Code	Credit-1			Practical Paper
			L	T	P	
Departmental Core - DC	Manufacturing Practices	100106	-	-	2	Max.Marks-30 Min.Marks-10

Course Objectives:

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

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 CONTENT: MECHANICAL ENGINEERING

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

1. **Discuss** the hand tools, machine tools and power tools.
2. **Identify** appropriate tools required for specific operation.
3. **Estimate** safety measures required to be taken while using the tools in floor shops, Machine ships and carpentry shop.
4. **Use** the techniques, skills, and modern engineering tools necessary for manufacturing and production engineering.
5. **Conduct** experiments in the field of Production engineering.
6. **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. Hazra Choudhry; workshop Practice-Vol.1 & 2.
5. Jain R. K.; Production Technology

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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COURSE CONTENT: MECHANICAL ENGINEERING

100204: Basic Mechanical Engineering

Category	Title	Code	Credit-6			Theory Paper
Departmental Core - DC	Basic Mechanical Engineering	100204	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	1	2	

Course Objectives:

1. To familiarize the students with the basics of Mechanical Engineering.
2. To impart knowledge about the various engineering materials, basic measurement system and basic of thermodynamics.
3. To impart knowledge of basic machines and methods encountered in engineering practice

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

1. **State** the working of IC and steam engines and thermodynamic cycles.
2. **Discuss** the fluid properties, pumps, compressors, turbines, various types of boilers, the mountings and accessories and able to calculate the boiler efficiency and to design the chimney dimensions.
3. **Operate** the machine tools like lathe, shaper and drilling machine
4. **Conduct** experiments, as well as to **analyze** and **interpret** data.
5. **Design** and realize a physical system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
6. **Implement** modifications in the area of mechanical systems and thermal systems.

Course of study and Scheme of Examination (*w.e.f.* July 2017)

Semester – III: B.E. (Mechanical Engineering)

S.NO.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End Sem.	Mid Sem.	Quiz/ Assignment	End Sem.	Lab Work & Sessional		L	T	P	
1.	BMEL-301	Mathematics-III	70	20	10	-	-	100	3	1	-	4
2.	BMEL-302	Mechanics of Materials-I	70	20	10	30	20	150	2	1	2	4
3.	BMEL-303	Manufacturing Process	70	20	10	30	20	150	2	1	2	4
4.	BMEL-304	Thermodynamics	70	20	10	30	20	150	2	1	2	4
5.	BMEL-305	Material Science	70	20	10	-	-	100	3	1	-	4
6.	BMEP-306	Machine Drawing Lab	-	-	-	30	20	50	-	-	4	2
7.	BMES-307	Idea Generation	-	-	-	-	50-	50	-	-	4	2
8.	BMES-308	Communication Skills	-	-	-	-	50	50	-	-	4	2
9.		NSS/NCC	-	-	-	-	- -	-	-	-	-	Qualifier
Total			**350**	**100**	**50**	**120**	**180**	**800**	**12**	**5**	**18**	**26**

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-302: Mechanics of Material – I

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core - DC	Mechanics of Material – I	BMEL-302	2	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objective

1. To understand the basic concepts of the stresses and strains for different materials and strength of structural elements.
2. To know the development of internal forces and resistance mechanism for one dimensional and two dimensional structural elements.
3. Applies analysis to members subjected to axial, bending, and tensional loads and calculate stresses and deformations of objects under external loadings.
4. To analyze and understand principal stresses due to the combination of two dimensional stresses on an element and failure mechanisms in materials.
5. Apply the Euler Equation to calculate axial buckling load for long straight columns of varying end conditions and materials.
6. To give an ability to apply the knowledge of strength of materials on engineering applications and design problem.

Syllabus

Unit- I Stress and strain: Stress-strain relationship and elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain, 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 in Tension, Compression and Shear, Strain Energy due to Principle Stresses, Strain Energy in Bending.

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

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

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 and Rosette: Strain Gauges - types of strain gauges, electrical strain gauges, Gauge factor, strain rosette

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COURSE CONTENT: MECHANICAL ENGINEERING

Course Outcomes

1. **State** fundamental concepts of stress and strain and their relationship.
2. **Illustrate** the effect of forces on deformable bodies.
3. **Calculate** the stresses and strains in various components of deformable bodies.
4. **Analyze** the various structural members subjected to tension, compression, torsion, bending and combined stresses.
5. **Choose** the appropriate materials in design considering engineering properties, sustainability, cost and weight.
6. **Evaluate** the behavior and strength of structural elements under the action of compound stresses and thus understand failure concepts.

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 Nostrand Compnay.
5. Mechanics of Solids **by** Mubeen; Pearson Education Pub.
6. Strength of Materials **by** S Ramamrurtham, R Narayan; Dhanpat Rai sons Pub.
7. Strength of Materials **by** Sadhu Singh; Khanna Publisher Pub.
8. Mechanics of Materials **by** Adarash Swaroop, New Age international Pub.

List of experiments (Expandable):

1. Standard tensile test on MS and CI test specimen
2. Direct/ cross Shear test on MS and CI specimen
3. Transverse bending test on wooden beams to obtain modulus of rupture
4. Fatigue test
5. Brinell Hardness tests
6. Vicker hardness test
7. Izod/ Charpy impact test.

BMEL-303: Manufacturing process

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core - DC	Manufacturing process	BMEL-303	2	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives:

1. To learn the various methods and types of castings, welding processes, sheet metal forming, powder metallurgy
2. Examine the principles associated with basic operations involving the forming, machining and welding of engineering materials;
3. Interpret the advantages and limitations of each process and its influence on the properties of the material in the finished component
4. To impart knowledge on selection of suitable manufacturing process for the typical component.
5. To make students aware of the necessity to manage manufacturing processes and systems for the best use of material and human resources with particular emphasis on product safety and environmental considerations.

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:

1. **Describe** the different types of manufacturing processes to achieve the required products with the aim of avoiding material and time wastage.
2. **Illustrate** suitable manufacturing process for typical components.
3. **Identify** the limitations of various machining processes with regard to shape formation and surface quality and the impact this has on design
4. **Classify** the application of the different joining techniques, and be able to select an appropriate technique according to a specific requirement.
5. **Compare** the procedures and techniques involved for the manufacturing of components
6. **Select** simplified manufacturing processes with the aim of reduction of cost and manpower.

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COURSE CONTENT: MECHANICAL ENGINEERING

Text & References 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, 2002.
4. Chapman, W.A.J., Workshop Technology, Vol - II, Oxford & IBH Publishing Co. Ltd., 1986
5. Amstead, B.H., P.F. Oswald and M.L. Begeman, Manufacturing Processes, 8th Edition, John Wiley and Sons Inc., New York, 1986.
6. Neibel, B.W., Alan B. Draper and R.A. Wysk, Modern Manufacturing Process Engineering, Mc Graw-Hill Publishing Co., New York, 1989.
7. Kalpakjian, S., Manufacturing Engineering and Technology, 2nd Edition, Addison-Wesley Publishing Co., New York, 1992.
8. E. Paul DeGarmo, J. Temple Black, and Ronald Kohser, Materials and Processes in Manufacturing, 7th Edition, Macmillan Publishing Co., New York, 1988.
9. John A. Schey, Introduction to Manufacturing Processes, 2nd Edition, McGraw-Hill Book Co., New York, 1987.

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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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-304: Thermodynamics

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core - DC	Thermodynamics	BMEL-304	2	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. To teach students the basic principles of classical thermodynamics and prepare them to apply basic conversion principles of mass and energy to closed and open systems.
2. To enable the students to understand second law of thermodynamics and apply it to various systems, note the significance of the results and to know about availability, entropy and second law aspects of daily life.
3. To teach students about properties of pure substances.
4. To teach students about fuels and combustion phenomenon, solve problems on stoichiometry, complete combustion, gravimetric and volumetric analysis.
5. Be in a position to check the feasibility of proposed processes and cycles using the ideas of second law of thermodynamics and entropy.

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:

1. **State** fundamental knowledge and understanding of basic principles of thermodynamics.
2. **Acquire** abilities to identify, formulate and solve mechanical engineering related problems.
3. **Explain** at a level understandable by a high school senior or non-technical person how various heat engines work (e.g. a refrigerator, an IC engine, a jet engine).
4. **Apply** ideal cycle analysis to simple heat engine cycles to estimate thermal efficiency and work as a function of pressures and temperatures at various points in the cycle.
5. **Design** and validate technological solutions to defined problems and write clearly and effectively, for the practical utilization of work.
6. **Develop** Intuitive problem solving technique.

Text &Reference Books:

1. Engineering Thermodynamics **by** P.K.Nag; TMH
2. Thermodynamics **by** Van GJ; John Wylen
3. Thermodynamics **by** Cengel Y;TMH
4. Thermodynamics **by** Arora C P;TMH
5. Thermal Engineering **by** R Yadav;
6. Engineering Thermodynamics **by** Omkar Singh; New Age International.
7. Engineering Thermodynamics **by** Ratha Krishanan; PHI India Pvt. Ltd.
8. Engineering Thermodynamics **by** M. Achuthan; PHI India.

List of Experiments

1. Study of basic concepts of thermodynamics.
2. Study of first law of thermodynamics with Joule's experiments.
3. Study of steady flow energy equation and its application in engineering.
4. Study of second law of thermodynamics.
5. Study to determine the calorific value of fuel using the bomb calorimeter.
6. Study to determine the higher calorific value of given gaseous fuel using Junkers gas calorimeter
7. Study to analyze the dry exhaust gas (DEG) from a combustion system using the Orsat apparatus.
8. Study of performance test on two stage reciprocating air compressor.

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-305: Material Science

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core - DC	Material Science	BMEL-305	3	1	0	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. To present the basic fundamentals of materials science and engineering.
2. To expose the reader community to different classes of materials, their properties, structures and imperfections present in them.
3. To stimulate student interest in and appreciation of Materials Science and Engineering by critical examination of engineering case studies, such as the materials design of hip prostheses, shuttle tiles, bicycles and electronic devices.
4. To introduce students to the functional properties of materials and the roles of microstructure, heat treatment defects and environment play in typical engineering applications.

Syllabus

Unit-I: Structure of Materials: Crystalline structure of solids: Concept of unit cell and space lattice, miller indices, Crystal structure of ferrous and non- ferrous metals. Crystal imperfections. Description of material properties like strength, hardness, toughness, ductility, brittleness, their importance in engineering application of materials and manufacturing. Quantitative evaluation of these properties with destructive testing methods.

Unit-II: Plastic Deformation: Crystal inspection: Mechanism of plastic deformation, role of dislocations, slip and twinning. Strain hardening and recrystallization. Elementary treatment of creep, fatigue and fracture.

Unit-III: Phase Diagrams: Phase and phase equilibrium: Solidification of pure metals and alloys, phase diagrams, eutectic, eutectoid, peritectic and peritectoid systems. Allotropy of iron and Fe-C diagram.

Unit-IV: Heat Treatment: Introduction and purpose of heat treatment: T-T-T curve and micro constituents in steel, heat treatment processes like hardening, tempering, annealing, and normalizing. Electrical, magnetic and optical properties of materials. Surface treatment processes.

Unit-V: Engineering Materials: Ferrous: Cast iron, carbon and alloy steels and their coding.

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

1. **State** the principles of diffusion theory.
2. **Discuss** fracture toughness, mechanical strength and loading configuration of a material component, maximum tolerable flaw size within a practical safety factor for given data.
3. **Compare** the heat treatment processes.
4. **Determine** the phases expected to be present, and calculate their compositions and the volume fraction of each phase for binary phase diagram and a particular alloy composition at a given temperature.
5. **Demonstrate** crystal structure, determine the crystallographic directions and planes, and the linear and planar atomic densities.
6. **Calculate** the final diameter of a drawn rod that will have a prescribed cold-worked strength for given data on strength versus cold work for an alloy.

Text & Reference Books

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

Course of study and Scheme of Examination (*w.e.f.* July 2017)

Semester – IV: B.E. (Mechanical Engineering)

S.No.	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End Sem.	Mid Sem. Test	Quiz/ Assignment	End Sem.	Term work / Lab Work & Sessional		L	T	P	
1.	BMEL-401	Machine Design-I	70	20	10	-	-	100	3	1	-	4
2.	BMEL-402	Metal Cutting and Machine Tools	70	20	10	30	20	150	2	1	2	4
3.	BMEL-403	Theory of Machine-I	70	20	10	30	20	150	2	1	2	4
4.	BMEL-404	Fluid Mechanics	70	20	10	30	20	150	2	1	2	4
5.	BMEL-405	Thermal Engineering	70	20	10	-	-	100	3	1	-	4
6.	BMEP-406	Simulation Lab –I		-	-	30	20	50	-	-	4	2
7.	BMES-407	Seminar/ Presentation/ GD		-	-	-	50	50	-	-	4	2
8.	BMES-408	Integrated Ethics and Attitude		-	-	-	50	50	-	-	4	2
9.	BMES-409	NSS/NCC	-	-	-	-	-	-	-	-	-	Qualifier
Total			**350**	**100**	**50**	**120**	**180**	**800**	**12**	**5**	**18**	**26**

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-401: Machine Design –I

Category	Title	Code	Credit-4			Theory Paper
Departmental Core – DC	Machine Design –I	BMEL-401	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	0	

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

Course Objectives: To make the students to understand:

1. To develop an ability to apply knowledge of mathematics, science, and engineering
2. To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
3. To develop an ability to identify, formulate, and solve engineering problems.
4. To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
5. To demonstrate the ability to make proper assumptions, perform correct analysis while drawing upon various mechanical engineering subject areas.

Syllabus

Unit-I Introduction: Definitions of Design, Design process, Factor of safety, national and international design standards and units.

Engineering Materials: Mechanical properties of materials, Selection of material in Mechanical Design. Design Consideration, Manufacturing Consideration: Standardization, surface finish symbols, Surface Roughness, limit, fit, tolerance, etc., Design for Manufacturability, Comparison between conventional design process and modern design process

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

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

Unit-IV Shafts, Keys and Couplings: Design of shaft under bending, twisting, axial, combined, fluctuating loads, Rigidity considerations. Types of keys and couplings, Material used for construction for keys.

Unit-V Belt and chain drive: Introduction, common materials, classification of belt drives, Flat belt, ratio of tensions, centrifugal tension, initial tension, V-belt, Introduction, classification, common materials of Chain drive.

COURSE OUTCOMES: After thorough knowledge of design of machine elements students will be able to:

1. **State** different machine elements with respect to design.
2. **Differentiate** the various drawing aspects i.e. elevations, plan and profile views
3. **Develop** the machine elements with respect to their failures.
4. **Apply** the basics of drawing in case of soft computing i.e. AUTO-CAD, ANSYS software's etc.
5. **Analyze** the industry oriented problems as case study.
6. **Create** new mechanism or modify the existing mechanisms.

Note: Sessional Work shall consist of Class work / homework, minimum 5 Drawing Sheets/ Computer Graphics of above mentioned machine parts and design problems.

Text & Reference Books

1. Machine Drawing **by** Bhat, ND; Charotar.
2. Machine Drawing **by** Narayana and Reddy; New age, Delhi.
3. Mechanical Engineering Design **by** Shigley JE et al; TMH
4. Text Book of Machine Drawing **by** John KC; PHI Learning
5. Machine Design **by** Mubeen
6. Design of Machine elements **by** Bhandari VB; TMH
7. Fundamental of Engg Drawing Interactive Graphics **by** Luzzader WJ, Duff JM; PHI.
8. Design data book **by** PSG
9. Mechanical design data book **by** Mahadevan and Reddy's;CBS

BMEL-402: Metal Cutting and Machine Tools

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Metal Cutting and Machine Tools	BMEL-402	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	2	

Course Objectives: To make the students to understand:

1. The course provides students with fundamental knowledge and principles in material removal processes.
2. In this course, the students apply the fundamentals and principles of metal cutting to practical applications through
3. To demonstrate the fundamentals of machining processes and machine tools.
4. To develop knowledge and importance of metal cutting parameters.
5. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.

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: introduction, 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

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COURSE CONTENT: MECHANICAL ENGINEERING

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

1. **Apply** cutting mechanics to metal machining based on cutting force and power consumption.
2. **Operate** lathe, milling machines, drill press, grinding machines, etc.
3. **Select** cutting tool materials and tool geometries for different metals.
4. **Select** appropriate machining processes and conditions for different metals.
5. **Optimize** parameters for material removal in unconventional machining processes.
6. **Identify** the process parameters, their effect and applications of different processes

Text & Reference Books

1. Fundamentals of Metal Cutting and Machine Tool **by** Boothroyd Geofery; McGH, Kogakuha Ltd.
2. Workshop Technology **by** Chapman, Volume I, II, & III, ELBS, 1980.
3. Production Technology **by** HMT;McGH Hill, New Delhi.
4. Production Technology **by** Jain, R.K. and Gupta, S.C;Khanna Publishers,1989.

List of Experiments (expandable)

1. To study and draw Geometry of single point cutting tool and tool angles
2. To study the characteristic features of lathe and perform the various operation.
3. To study the characteristic features of Milling machine and perform various operations.
4. To study the characteristic features of Shaper and planner and perform various operations.
5. To study the modern gear manufacturing methods.
6. To study the abrasive and surface finish process.
7. To study the non- conventional machines

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL403: Theory of Machines-I

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core - DC	Theory of Machines-I	BMEL-403	2	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives

1. To familiarize students with basic types of mechanisms, joints and degrees of freedom to perform position, velocity and acceleration analysis using graphical and analytical methods.
2. To provide students an understanding of different types of mechanisms.
3. To teach the basics of synthesis of simple mechanisms.
4. To enable students to apply fundamental of mechanics to machines which include engines, linkages etc.,
5. To facilitate students to understand the function of flywheels and reciprocating masses

Syllabus

Unit-I Introduction: Machine, Mechanism, Kinematics Links, Pairs, Chains, 4-bar chain, Inversions of Slider & Double Slider crank chains, 4 bar chain, degree of freedom. Lower pair mechanisms -pantograph, Straight line motions.

Unit-II Motion: Plane motion, absolute and relative motion, displacement, Velocity and acceleration of a point, velocity and acceleration in mechanisms, relative velocity method, instantaneous centre method, centroids, Kennedy's Theorem, Klein's construction. Acceleration diagram, Coriolis component, problems of slider crank mechanism and its inversion, 4-bar chain etc. Analytical treatment for velocity and acceleration of piston and connecting rod of an engine.

Unit-III Dynamic Analysis of Mechanisms and Machines: Motion of rigid body subjected to a system of forces. D'Alembert's principle. Equivalent dynamical system, Graphical and analytical methods of dynamic forces analysis of mechanisms and machines including reciprocating engines, turning moment diagrams and Flywheel analysis.

Unit-IV 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.

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

Course Outcome: Upon successful completion of the course student will be able to:

1. **Demonstrate** an understanding of the concepts of various mechanisms and pairs.
2. **Identify** the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism.
3. **Determine** the degrees-of-freedom (mobility) of a mechanism
4. **Apply** the fundamental principles of statics and dynamics to machinery
5. **Analyze** the dynamical problems of machines.
6. **Analyze** the fundamentals of machines for desired kinematic or dynamic performance.

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COURSE CONTENT: MECHANICAL ENGINEERING

Text & Reference Books

1. Theory of Machines **by** Rattan, SS; TMH
2. Theory of Machine **by** Norton, RL; TMH
3. Theory of Machine **by** Ballaney, 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 **by** Rao, JS and Dukkipati; NewAge Delhi.
8. Theory of Machines **by** Lal, Jagdish; Metropolitan Book Co; Delhi –
9. Theory of Mechanisms & Machines **by** Ghosh, A.,Mallik,AK; Affiliated East West Press,Delhi.

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

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-404: Fluid Mechanics

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Fluid Mechanics	BMEL-404	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	2	

Course Objectives: To make the students to understand:

1. To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. To give fundamental knowledge of fluid, its properties and behaviour under various conditions of internal and external flows.
3. To 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.
4. To imbibe basic laws and equations used for analysis of static and dynamic fluids.
5. To inculcate the importance of fluid flow measurement and its applications in Industries.

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, Buoyance, flotation, stability of floating bodies.

Unit-II Fluid Kinetics: One dimensional flow approximation, control, volumes concept, Reynolds transport theorem, continuity equation in 3-D, its differential and integral form, velocity and acceleration of fluid particle stream line, stream line path, stream line path line. Rotation, vorticity and circulation. Stream velocity potential function. Flow net, Free, 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, Pilot-static probe, Current meters. Venturi meter, Orifice meter, Rotameter, Nozzle meter, Notches & weirs.

Unit-IV Dimensional Analysis: Rayleigh's method, Buckingham's Pie theorem, physical significance of various dimensionless numbers, Similarity concept, Geometric, kinematic and dynamic similarity, Model testing and its applications.

Unit-V 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 Transmission of power through pipes.
Boundary Layer Theory: Development of boundary layer over flat plate and pipe, boundary layer thickness displacement energy, and momentum thickness, integral equation.

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

1. **State** the Newton's law of viscosity and **Explain** the mechanics of fluids.
2. **Compute** force of buoyancy on a partially or fully submerged body and **Analyse** the stability of a floating body.
3. **Derive** Euler's Equation of motion and **Deduce** Bernoulli's equation.
4. **Examine** energy losses in pipe transitions and **sketch** energy gradient lines.
5. **Evaluate** pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe.
6. **Distinguish** the types of flows and **Determine** sonic velocity in a fluid.

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COURSE CONTENT: MECHANICAL ENGINEERING

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 **by** Yunus A Cengel & John M. Cimbala; Tata McGraw Hill Edition.

List of Experiments

1. Calculate the coefficient of discharge of Venturimeter.
2. Calculate the Cd, Cv and Cc through Orifice meter.
3. Calculate the Cd through Notch.
4. Calculate the Coefficient of Friction through Pipe Set Apparatus.
5. Study of Pressure Distribution curve around a cylinder and Aerofoil.
6. Study of boundary layer over a flat plate, Boundary layer Thickness, Displacement thickness along with Integral Moment.
7. Study of Viscosity of given oil through Redwood Viscometer.
8. Study of Coefficient of friction between flowing Apparatus.
9. Calculate the Critical Reynolds's Number through Pipe Set Apparatus.

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-405: Thermal Engineering

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Thermal Engineering	BMEL-405	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	0	

Course Objectives: To make the students to understand:

1. To familiarize students with basic concepts of units and dimensions, systems (open and closed systems and control volumes) and its boundaries, properties, state, process, cycle, quasi-static process etc.- required as foundation for development of principles and laws of thermodynamics.
2. To enable students to develop Intuitive problem solving technique.
3. To study Air-vapour cycles, and Nozzle, diffuser applications.
4. To understand the fuel combustion phenomenon and working of steam generators.

Syllabus

Unit I Air standard 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**.**

Unit II Vapor power cycles :- 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.Introduction of condensers.

Unit III Nozzles and diffuser :- Introduction , SFEE and continuity equation for nozzles, momentum equation for steam nozzle, entropy change due to friction in nozzle, nozzle efficiency, critical pressure , stagnation enthalpy & pressure, Relation between area, velocity & pressure in nozzle, effect of friction on critical pressure ratio, supersaturated flow in nozzles, effect of variation of back pressure.

Unit IV Fuels and Combustion of Fuel : Types of fuels, Combustion, Determination of minimum air required for combustion. Conversion of volumetric analysis to mass Analysis. Determination of air required when volumetric analysis fuel gases is known. Determination of Excess air Determination of Calorific value of fuels. Bomb calorimeter, Orsat apparatus Junkers gas calorimeter.

Unit V Steam generators:- Water tube boilers, high pressure boilers, combustion equipment for steam boilers, boiler mountings and accessories, Draught, chimney height and diameters, condition for maximum discharge through chimney, draught losses, artificial draught, steam jet draught, performance of steam generators, equivalent evaporation, factor of evaporation, boiler efficiency, heat losses in boilers.

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

1. **State** the basic concepts of thermal sciences and their application to in formulating the thermal engineering problems.
2. **Examine** the equivalent evaporation of steam generators.
3. In a position to check the feasibility of proposed processes and cycles.
4. **Analyze** basic power cycles and apply the laws of thermodynamics to various thermodynamic applications.
5. **Explain** fuel combustion and its application.
6. **Describe** and assess benefits of improvements to thermal systems.

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COURSE CONTENT: MECHANICAL ENGINEERING

Text & Reference Books:

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

BMEP-406: Simulation lab

Category	Title	Code	Credit-2		
Departmental Core-DC	Simulation lab	BMEP-406	L	T	P
			0	0	4

Course Objectives: To make the students to understand:

1. Conventions and symbols as per ISI recommendations.
2. Assembly and sub-assembly drawings of machines.
3. Model simple assemblies and sub-assemblies of machine parts.
4. Sharpen creative skills in developing new ideas.
5. Improve communication skills through technical drawings.

Syllabus

1. Concept of Machine drawing, orthographic projection, and sectioning.
2. Assembly Drawing such as plummer block, pedestal bearing etc.
3. CAD hardware and software. AutoCAD, CATIA commands.
4. 2D-3D modelling and computer aided drafting concept.
5. Design and drawing of parts contained in the syllabus.

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

1. **Describe** conventions, symbols and standards used in engineering drawing as per ISI recommendations.
2. **Construct** part and assembly drawings of different machines assemblies and sub-assemblies.
3. **Apply** CADD packages like AutoCAD/CATIA.
4. **Sketch** simple assemblies and sub-assemblies of machine parts and prepare part and assembly drawings using soft packages.
5. **Communicate** through technical drawings of machine assemblies as a design engineer.
6. **Explain** in details the concept of drawings in CAD and apply the same in day to day requirements in industry.

Text & Reference Books

1. Machine Drawing **by** P. S. Gill; Katson Publishing House.
2. Machine Drawing **by** N. Sideshwar, P. Kannaih and V. V. Sastry;Tata McGraw.
3. Auto CAD Concise Guide to Command Features **by** R. W. Leigh; Galgotia Publications.
4. The illustrated auto CAD Book **by** Tom W. Berghauser.

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COURSE CONTENT: MECHANICAL ENGINEERING

Course of study and Scheme of Examination (*For batches admitted in July, 15 & July, 16 (Implemented in July, 2017*)

B.E. V Semester (Mechanical Engineering)

S.No.	Subject Code	Subject Name		Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
				Theory Slot			Practical Slot						
				End Sem	Mid Sem	Quiz/Assignment	End Sem	Lab work & Sessional		L	T	P	
1.	**BMEL- 501**	**Elective-I***	**Metrology, Measurement and Control**	70	20	10	-	-	100	3	1	-	**4**
	BMEL - 502		**Aerospace propulsion**										
2.	**BMEL - 503**	**Advance Mechanics of Materials**		70	20	10	30	20	150	3	1	2	**5**
3.	**BMEL - 504**	**Industrial Engineering**		70	20	10	-	-	100	3	1	-	**4**
4.	**BMEL- 505**	**Internal Combustion Engine**		70	20	10	30	20	150	3	1	2	**5**
5.	**BMEL - 506**	**Machine Design-II**		70	20	10	30	20	150	3	1	2	**5**
6.	**BMEP - 507**	**Simulation Lab – II**		-	-	-	30	20	50	-	-	2	**1**
7.	**BMES - 508**	**Self Study (Internal Assessment)**		-	-	-	-	50	50	-	-	2	**1**
8.	**BMES - 509**	**Seminar & Group Discussion (Internal Assessment)**		-	-	-	-	50	50	-	-	2	**1**
		Total		**350**	**100**	**50**	**120**	**180**	**800**	**15**	**5**	**12**	**26**

L: Lecture T: Tutorial P: Practical .

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

Elective-I*	Metrology, Measurement and Control	Aerospace propulsion	Composite Materials	Additive Manufacturing

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-501: Metrology, Measurement and Control

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Elective-I	Metrology, Measurement and Control	BMEL-501	3	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. Types of errors, design of limit gauges and various comparative measurements.
2. 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. Use of control chart.

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** and **discuss** limit gauges.

Revised Co VC 24/09/18

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

1. **Describe** the basic of standards of measurement, limits, fits & tolerances.
2. **Compare** quality in engineering products through different measurement techniques..
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** and **Propose** the limit gauges for measurement of component..

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.

BMEL-502: Aerospace Propulsion

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	Max.Marks-70 Min.Marks-22
Elective-I	Aerospace Propulsion	BMEL-502	3	1	-	Duration-3hrs.

Course Objective:

1. To aware the students regarding space technology as national and international level.
2. To enable the students to understand air craft propulsion and its element; and application of thermodynamics in it.
3. To enable the students to understand rocket propulsion and its element; and application of thermodynamics in it.

Syllabus

Unit 1: Introduction: Introduction to world space program scenario -an overview. Introduction to Indian Space Research Organization; Planetary sciences and astronomy. India's achievements in the space activities and its contribution to the nation's growth.

Unit 2: Aircraft Propulsion: Main propulsion engines; Engine cycle; Performance parameters; Efficiency of propulsion system; Thermodynamics of Aircraft jet engines, Aerothermodynamics of inlet, combustors, and nozzles.

Unit 3: Aircraft prolusion element: Compressors; Work and compression, design of a subsonic axial compressor, transonic fan stage. Axial turbine; stage efficiency, stresses, performance and design. turbine and compressor matching.

Unit 4: Rocket propulsion: Rocket engines, solid propellant rocket, liquid rocket engines; Performance of rocket vehicles.

Unit 5: Rocket Propulsion elements: Feed system, combustion and expansion; Liquid rocket stage electrical rocket propulsion. Liquid rocket propellants; earth storable propellants and cryogenics propellants.

Course Outcome: After successfully completion of this course student will be able to:

1. **Identify** the aerospace activity and its contribution to the nation
2. **Apply** knowledge of aircraft propulsion and rocket elements.
3. **Apply** and design the elements of aerospace propulsion.
4. **Analyze** the aircraft propulsion and rocket elements problems.
5. **Evaluate** the propulsion design and parameters.
6. **Create** and **Design** the elements of aerospace propulsion engines.

Text & References Books::

1. Mechanics and thermodynamics of propulsion **by** Philip Hill and Carl, Peterson, Addision Wesley.

2. Elements of propulsion, Gas turbines and rockets, **by** J D Mattingly, 2006,AIAA education series, Mc-Graw Hill.
3. Understanding Aerospace Chemical Propulsion **by** H.S. Mukunda, Interline Publishing, Bangalore.
4. Rocket Propulsion Elements **by** George P Sutton and Oscar Biblarz.
5. Design of liquid Propellant Rocket Engine **by** Dieter K.Huzel, NASA SP 125, Willey India Pvt limited.
6. Gas Turbine Theory **by** HIH Sarvanammuttoo H Cohen, Pearson.
7. Rocket and Aircraft Propulsion (Principles, practice and new Developments) **by** Turner Springer Published in association with Praxis Publishing UK.
8. Aircraft power plant **by** Kroes Michael J, Tata McGraw Hills.
9. Aircraft Propulsion and gas turbine engines **by** Ahmed F. El-Sayed, Taylor and Francis ,CRC press.

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COURSE CONTENT: MECHANICAL ENGINEERING

Category	Title	Code	Credit-4			Theory Paper
Elective-I	Composite Materials	------	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives:

1. To learn about the benefits gained when combining different materials into a composite.
2. To understand different processing methods, issues, properties and testing methods of different composite materials.
3. To introduce students to the functional properties of materials and the roles of microstructure, heat treatment defects and environment play in typical engineering applications.

UNIT I : INTRODUCTION TO COMPOSITES:

Fundamentals of composites – need for composites – enhancement of properties – classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

UNIT II : POLYMER MATRIX COMPOSITES :

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes – hand lay up processes – spray up processes – compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Laminates-Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-applications of PMC in aerospace, automotive industries

UNIT III: METAL MATRIX COMPOSITES:

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties- applications of MMC in aerospace, automotive industries

UNIT IV : CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES :

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics – need for CMC – ceramic matrix – various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering – Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). applications of CMC in aerospace, automotive industries-Carbon /carbon composites – advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol-gel technique- Processing of Ceramic Matrix composites.

UNIT V : MECHANICS OF COMPOSITES :

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. QuasiIsotropic Laminates. Determination of Lamina stresses within Laminates.

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COURSE CONTENT: MECHANICAL ENGINEERING

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

1. **Define** different materials and their composition.
2. **Discuss** the different techniques to process different types of composites and know the limitations of each process.
3. **Analyze** different material to design composites.
4. **Determine** the phases expected to be present, and calculate their compositions and the volume fraction of each phase for binary phase diagram and a particular alloy composition at a given temperature.
5. **Demonstrate** crystal structure, determine the crystallographic directions and planes, and the linear and planar atomic densities
6. **Apply** mathematical techniques to predict the macroscopic properties of different Laminates

TEXT BOOKS:

- Mathews F. L. and Rawlings R. D., "Composite Materials: Engineering and Science", 1st Edition, Chapman and Hall, London, England, 1994.
- Chawla K. K., "Composite materials", Second Edition, Springer – Verlag, 1998.

REFERENCES:

- Clyne, T. W. and Withers, P. J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
- Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
- Sharma, S.C., "Composite materials", Narosa Publications, 2000.
- Broutman, L.J. and Krock,R.M., " Modern Composite Materials", Addison-Wesley, 1967.
- ASM Hand Book, " Composites", Vol.21, ASM International, 2001.

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COURSE CONTENT: MECHANICAL ENGINEERING

Category	Title	Code	Credit-4			Theory Paper
Elective-I	Additive Manufacturing	------	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives:

1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

UNIT I : INTRODUCTION

Overview – History – Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling – Applications.

UNIT II : CAD & REVERSE ENGINEERING

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III : LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT IV : POWDER BASED ADDITIVE MANUFACTURING SYSTEMS

Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT V : MEDICAL AND BIO-ADDITIVE MANUFACTURING

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

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

1. **Define** the different additive manufacturing techniques.
2. **Discuss** the principle of reverse engineering and its applications
3. **Compare** different method and discuss the effects of the Additive Manufacturing technologies.
4. **Analyze** the characteristics of the different materials in Additive Manufacturing.
5. **Evaluate** the performance of different additive manufacturing techniques.
6. **Create** a model and prototype using additive manufacturing technique.

TEXT BOOKS:

- Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
- Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

REFERENCES:

- Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
- Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. 3. Hilton P.D. and Jacobs P.F., "Rapid
- Tooling: Technologies and Industrial Applications", CRC press, 2000.

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL – 503: Advance Mechanics of Materials

Category	Title	Code	Credit-5			Theory Paper
Departmental Core-DC	Advance Mechanics of Materials	BMEL - 503	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	2	

Course Objectives: To make the students to understand:

1. Static equilibrium of particles and rigid bodies
2. Dynamic equilibrium of rigid bodies in solving basic problems in engineering mechanics
3. To give an ability to calculate stresses and deformations of objects under external loadings.
4. To give an ability to apply the knowledge of mechanics of materials on engineering applications.
5. To give an ability to apply the knowledge of mechanics of materials on design problems.

Syllabus

UNIT- I FIXED BEAMS: Maculay's method - fixed beam with isolated load not at mid-span, fixed beam carrying UDL, fixed beam subjected to a couple at any point. **Continuous Beam:** Claypron's theorem of three moments, C –frame.

UNIT- II STRAIN ENERGY: Strain energy due to direct stress, simple shear, torsion, bending, shear force in beams. Energy theorems: **Distortion energy, Castigliono's –II theorem, Betti's theorem, Maxwell theorem**

UNIT-III THICK AND COMPOUND CYLINDER: Thick wall cylinder & spherical shells, stresses due to external and internal pressure, change in diameter & Volume, compound cylinder, Shrink fitting.

UNIT-IV THEORIES OF FAILURE: Maximum Principle Stress Theory, Maximum Principle Strain Theory, Maximum Shear Stress Theory, Total Strain Energy Theory, Distortion Energy Theory, Octahedral Shear Stress Theory. **Rotating Rim & Discs:** Stresses in thin rotating rims, stresses in circular discs of uniform thickness due to rotation, hollow discs, and discs of constant stress.

UNIT-V EXPERIMENTAL STRESS ANALYSIS: Brittle coating, Strain Gauge, Photo elasticity. Introduction to stress analysis by finite element method.

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

1. **Compare** the behavior of materials under different loads and pressure.
2. **Calculate** stresses in open and closed sections in torsion and bending of standard sections.
3. **Apply** stress functions in plates, shells, thick circular cylinders and discs.
4. **Analyze** the strength, predict failure and incorporate design considerations in pressure vessels and beams.
5. **Evaluate** the failure of beam and thick cylinders at different load conditions.
6. **Create** data required for design and analysis of beam, pressure vessels and thin disc.

Text & References Books:

1. Arthur P Boresi, Richard J. Schmidt, "Advanced mechanics of materials", John Wiley.
2. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.
3. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc-millan pub. Co..
4. Srinath. L.S., "Advanced Mechanics of solids", Tata McGraw Hill..
5. G H Ryder Strength of Materials Macmillan, India Ltd.

List of Experiments:

1. Study of Fixed and Continuous Beams.
2. Study of various theories of failures.
3. To develop the code for measuring the stresses due to external and internal pressure.
4. Study of strain gauge technique used for stress analysis.
5. Study of the photo elasticity approach.
6. Study the different problems using FEM.
7. To find the strain of given component.

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-504: Industrial Engineering

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Industrial Engineering	BMEL-504	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	0	

Course Objectives: To make the students to understand:

1. Assume professional, technical managerial, or leadership roles within industrial organizations and
2. Apply knowledge through discovery, synthesis, and integration for the betterment of their organization or society at large

Syllabus

UNIT-I INTRODUCTION:

Introduction to Industrial Engineering, Evolution of key Concepts, History, Development, Applications, Scope & function of industrial engineering. **Work Study**: Definition, objective and scope of work study. Human factor in work study, Work study and management, work study and supervision, work study and worker. **Motion Study**: Introduction to Method Study, Definition, objective and scope of method study, activity recording and exam aids. Process analysis, Flow diagram, Activity chart, Man & machine charts, Left hand- Right hand charts, SIMO charts, Micro motion study and their applications, Motion study equipments, and micro motion study. Development, definition and installation of the improved method. Principles of Motion economy as applied to the human body, work place and design of tools and equipments.

UNIT-II TIME STUDY:

Introduction, Equipment, Procedure, Performance Rating, Rating techniques and use of rating, Normal time, Standard Time, Allowances, Elemental Time data and their use, Predetermined Motion Time data systems, Work factor, M.T.M., Work sampling. **Wages and Incentives**: introduction, definition, wage differentials, methods of wage payment, Advantages, disadvantages, financial incentives, non-financial incentives. **Ergonomics**: Introduction, areas of study under ergonomics, man-machine system, study of development of stress in human body and their consequences, types of control, layouts of panels and machines. Design of work places, influence of climate on human efficiency. Influence of noise, vibration and light on human efficiency.

UNIT-III PRODUCTION & PRODUCTIVITY:

Production, Production Function, Production System, Input-output Model, Definition of productivity, Measurement of productivity, factors affecting the productivity, causes of low productivity, productivity improvement programs. **Production Planning and Control:** Introduction, Production Planning, Production Control, Routing, Scheduling, Dispatching, follow up & Progress Report, assembly line balancing. **Forecasting techniques**: Introduction, need and type of forecasting, forecasting models: causal and time series models Moving average, exponential smoothing.

UNIT-IV PRODUCT DESIGN AND DEVELOPMENT:

Principles of good product design, tolerance design; quality and cost considerations; Break-even analysis, product development, product life cycle; standardization, simplification, diversification. **Facilities location & Layout**: Concept and factors governing facilities location and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques.

UNIT-V MATERIALS MANAGEMENT:

Introduction, Scope & objectives of Materials Management, A-B-C- Analysis. Value engineering and analysis: Introduction, objective, Methodology, Applications. Introduction of Material Handling system; Concurrent engineering; Capacity planning, Materials requirement planning, Bill of Material, MRP-I, MRP-II, JIT, 5S Principles, six sigma; total quality management and TPM.

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

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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COURSE CONTENT: MECHANICAL ENGINEERING

1. **Apply** knowledge of mathematics, science, and engineering.
2. **Conduct** experiments, as well as **analyze** and **interpret** data.
3. **Design**, **develop**, **implement** and **improve** a component, process, or integrated system of people, materials, information, equipment, and energy to meet desired needs within realistic constraints
4. **Identify**, **formulate**, and **solve** engineering problems.
5. **Recognize** professional and ethical responsibility.
6. **Develop** engineering solutions in a global, economic, environmental, and societal context.

Text & References Books:

1. ILO-Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd.
2. Ralph M Barnes-Motion and Time study, ISBN:13:978981426182 Publisher: John Wiley,
3. M S Sanders and E J McCormic-Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill.
4. R.S.Bridger-Introduction to Ergonomics, ISBN:13:9780849373060, Publisher Taylor and Francis.
5. Work study and Ergonomics: Work study and ergonomics, By K.C. Jain et al. New age Publishers
6. Modern Production/Operations Management, Buffa and Sarin, Wiley Eastern Ltd.
7. Production and Operations Management, Pannerselvam. R., PHI.
8. Industrial Engineering and operation Management, O. P. Khanna
9. Industrial Engineering and operation Management , Banga and Sharma

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-505: Internal Combustion Engine

Category	Title	Code	Credit-5			Theory Paper
Departmental Core-DC	Internal Combustion Engine	BMEL-505	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	2	

Course Objectives: To make the students to understand:

1. Construction and operation of IC Engine
2. Fuels and Combustion in IC Engines so in future we used alternative fuels.
3. Testing and check the Performance of IC engine calculate power output and losses.
4. Gain knowledge about firing order in multi cylinders
5. Design of combustion chambers in SI and CI engine and solve the problems of abnormal combustion and power output of engine.

Syllabus

UNIT I - ENGINE CONSTRUCTION AND OPERATION:

Four stroke SI and CI engines - Working principle - function, materials, constructional details of engine components - 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 engine operation.

UNIT II - FUELS AND COMBUSTION:

Combustion equation, conversion of gravimetric to volumetric analysis - Determination of theoretical minimum quantity of air for complete combustion - Determination of air fuel ratio for a given fuel. Properties and rating of fuels (petrol and diesel), chemical energy of fuels, reaction equation, combustion temperature, combustion chart.

UNIT III - COMBUSTION IN SI ENGINES:

Combustion in premixed and diffusion flames - Combustion process in IC engines. Stages of combustion - Flame propagation - Flame 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 - types, factors controlling combustion chamber design.

UNIT IV - COMBUSTION IN 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. CI engine combustion chambers - Combustion chamber design objectives - open and divided. Induction swirl, turbulent combustion chambers. - Air cell chamber - M Combustion chamber.

UNIT V - ENGINE PERFORMANCE:

Performance parameters - BP, FP, IP, Torque specific fuel consumption, Specific Energy consumption, volumetric efficiency, thermal efficiency, mechanical efficiency, Engine specific weight, and heat balance. Testing of engines – different methods. Numerical problems.

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COURSE CONTENT: MECHANICAL ENGINEERING

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

1. **Explain** different types of reciprocating internal combustion engines (ICE), their typical design features and performance characteristics.
2. **Discuss** challenges related to industrial application.
3. **Identify** Possibilities and limitations of using a simulation program for engine performance
4. **Analyze** thoughts and reasoning in current engine development
5. **Evaluate** the design and operation of internal combustion engines affect their performance, operation, fuel requirements, and environmental impact.
6. **Compare** the different type fuel injection system in SI and CI

Text & References Books:

1. Ganesan V, "Internal combustion engines", 4th edition, Tata McGraw Hill Education.
2. Rajput R. K, "A textbook of Internal Combustion Engines", 2nd edition, Laxmi Publications (P) Ltd.
3. John. B, Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., New York .
4. Ramalingam K. K, "Internal Combustion Engines", Second Edition, Scitech Publications.
5. Sharma S. P, Chandramohan, "Fuels and Combustion", Tata McGraw Hill Publishing Co, 1987.
6. Mathur and Sharma, "A course on Internal combustion Engines", Dhanpat Rai & Sons, 1998.
7. Edward F, Obert, "Internal Combustion Engines and Air Pollution", Intext Education Publishers.

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-506: Machine Design-II

Category	Title	Code	Credit-5			Theory Paper
Departmental Core-DC	Machine Design-II	BMEL-506	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	2	

Note: Use of Design data book is permitted in Examination.

Course Objective:

1. To understand the procedure of design of various machine elements
2. To be familiar with design and operations of I C engine parts
3. To give knowledge of stress concentration and fatigue used in design procedures
4. To learn the drafting of Engine parts in modeling software
5. To understand about functioning of machine elements

Syllabus

UNIT- I STRESS CONCENTRATION & FATIGUE:
Stress Concentration, Causes of stress concentration, stress concentration tension, bending and torsion, mitigation of stress concentration, cyclic loading, endurance limit, S-N curve, concentration factor, notch sensitivity, design consideration for fatigue, Goodman and modified Goodman's diagram, Soderberg's equation, Gerber's parabola, design for finite life, Cumulative fatigue damage factor.

UNIT - II CLUTCHES:
Function, Types of clutches, Applications, Torque transmission and Energy dissipation during clutching. Types, Materials, Disk clutch, clutch-load characteristics, Drum brakes, Energy absorbed by the brakes, Dissipation of heat. Band brakes, block brakes, Internal & External phue brakes.

UNIT – III 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, special springs, design of leaf spring.

UNIT – IV I C ENGINE PARTS:
Detailed design and drawing of piston, connecting rod, crankshaft, Flywheel, Cylinder.

UNIT –V GEARS:
Design of Spur, Helical, worm and Bevel Gears

Course Outcome:

1. **Describe** the design procedure used in automotive industry to design the engine parts
2. **Classify** the different Clutch and brakes system, different types of spring and Gears
3. **Choose** the right strategy for designing the machine components based on material and methods
4. **Apply** the design procedure for solving and drafting the different design of machine elements
5. **Compare** the various curves and design procedure used
6. **Design** the Engine parts equipped with standard design procedures

Note: **Sessional Work shall consist of Class work / homework, minimum 5 Drawing Sheets/ Computer Graphics of above mentioned machine parts and design problems.**

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COURSE CONTENT: MECHANICAL ENGINEERING

Text & References Books

1. Joseph Edward Shigley and Charles, R. Mischke, (Mechanical Engineering Design, McGraw –Hill International Editions. Eighth Edition. .
2. Bhandari.V.B. "Design of Machine elements", Tata Mc Graw Hill Book Co.
3. R.S.Khurmi, J.K.Gupta. "Machine Design", Eurasia Publishing House (Pvt.)
4. Design Data book– PSG College of Technology, Coimbatore.
5. Juvinal, R.C., Fundamentals of Machine component Design, John Wiley.

List of Experiments / Drawing sheets:

1. Design and drawing of Piston.
2. Design and drawing of cylinder.
3. Design and drawing of connecting rod.
4. Design and drawing of Crankshaft.
5. Design and drawing of flywheel.
6. Design and drawing of helical spring.
7. Design and drawing of Spur gear
8. Design and drawing of Helical gear
9. Design and drawing of Worm gear
10. Design and drawing of bevel gear
11. Modeling and simulation of Gear box

Note: All drawing should be made in CATIA software and printed in required format (A3 size paper with Isometric view, Top view, Front view, material details with Title block).

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEP-507: Simulation Lab-II

Category	Title	Code	Credit-1			Practical Lab
Departmental Core-DC	Simulation Lab-II	BMEP-507	L	T	P	Max. marks: 30 Min. Marks: 10
			0	0	2	

Course objectives: To make the student to understand:

1. To understand the concept of 2D and 3D modelling and Simulation software
2. Create and modify complex 2D and 3D entities using CATIA CAD software
3. To understand the concept of programming using SCI lab and MATLab software.
4. Sharpen creative skills in developing new ideas.

Syllabus

UNIT-I: CATIA
Geometrical modelling and application of modelling packages, Assembly

UNIT-II : PROGRAMMING SOFTWARES
Introduction to SCI lab and MATLAB with its applications, programming methods.

UNIT-III : SIMULATION
Introduction to modelling and simulation, wire frame, surface and solid models, 3D models

UNIT-IV: PRINCIPAL OF SIMULATION
Types of simulation, Monte Carlo simulation

UNIT-V: APPLICATION
Simulation package of CNC software for turning and milling Operation.

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

1. **Create** simple and complex 2D and 3D solid models.
2. **Perform** simulation using CATIA software .
3. **Improve** their communication skills through technical drawings of machine assemblies as a design engineer.
4. **Generate** Programming using SCILab and MATLab software.
5. **Solve** real time problem.
6. **Design** a various mechanical engineering problems.

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COURSE CONTENT: MECHANICAL ENGINEERING

Course of study and Scheme of Examination

(*For batches admitted in July, 15 & July, 16 (Implemented in July, 2017*)

B.E. VI Semester (Mechanical Engineering)

S.No	Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot						
			End sem	Mid Sem	Quiz/Assignment	End Sem	Lab work & Sessional		L	T	P	
1.	**BMEL- 601**	**Principles of Management & Managerial Economics**	70	20	10	-	-	100	3	1	-	**4**
2.	**BMEL- 602**	**Elective-II*** **Computer Integrated Manufacturing**	70	20	10	-	-	100	3	1	-	**4**
	BMEL- 603	**Power Plant Engineering**										
3.	**BMEL - 604**	**Operation Research & Supply Chain**	70	20	10	30	20	150	3	1	2	**5**
4.	**BMEL – 605**	**Turbo Machinery**	70	20	10	30	20	150	3	1	2	**5**
5.	**BMEL - 606**	**Dynamics of Machines**	70	20	10	30	20	150	3	1	2	**5**
6.	**BMEP - 607**	**Minor Project**	-	-	-	30	20	50	-	-	2	**1**
7.	**BMES - 608**	**Self Study (Internal Assessment)**	-	-	-	-	50	50	-	-	2	**1**
8.	**BMES - 609**	**Seminar & Group Discussion (Internal Assessment)**	-	-	-	-	50	50	-	-	2	**1**
		Total	**350**	**100**	**50**	**120**	**180**	**800**	**15**	**5**	**12**	**26**

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit Self Study May be adopted through NPTEL/ MOOC/ SWAYAM**

Elective-II*	**Computer Integrated Manufacturing**	**Power Plant Engineering**	**Unconventional Machining Process**	**Fracture Mechanics**

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-602: Computer Integrated Manufacturing

Category	Title	Code	Credit-4			Theory Paper
Elective -II	Computer Integrated Manufacturing	BMEL-602	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	0	

Course objectives: To make the student to understand:

1. To use computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.
2. To learn the part programming, importance of group technology, computer aided process planning, computer aided quality control and feedback systems.
3. To understand the different Manufacturing Systems and Planning of FMS Analysis Methods.
4. To learn the automation and brief history of robot configuration, Programming & Applications.
5. To learn the overall configuration and Computerized Manufacturing Planning System.

Syllabus

UNIT-I INTRODUCTION & PRODUCT DEVELOPMENT THROUGH CAD AND CAE:

Workstations, an overview of CIM softwares. Geometric modeling techniques, Automated Drafting, Graphic Standards. Engineering analysis, Optimization, Princples of Concurrent Engineering.

UNIT-II AUTOMATED PROCESS PLANNING & CNC TECHNOLOGY:

Process planning, general methodology of group technology, code structures, variant and generative process planning methods. Principles of numerical control, types of CNC machines, features of CNC systems, integration of CNC machines in CIM environment, DNC- Flexible manufacturing systems. **NC Programming :** 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, CAD/CAM approach of programming .Computer numerical control, direct and distributed numerical control, adaptive control.

UNIT-III ELEMENTS OF COMPUTER AIDED MANUFACTURING SYSTEM:

CAD/CAM-CPU, memory Input/output, Data representation and computer programming languages, operating Computer system, Mini and micro Computers Programmable Controller. Elements of computer Aided design, Design Processes Creating manufacturing data base: The design Workstation, Graphics terminal, The software configuration of graphic packages, Constructing and Geo-modeling, Wire frame versus Solid Modeling. CAD/CAM Integration.

UNIT-IV 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-VAUTOMATED QUALITY CONTROL:

Integration of Quality control with CAD/CAM, Statistical process control, objectives of CAQC types of CMM, non Contact inspection methods, in process and process metrology, flexible inspection Contact inspection methods, in process and post process metrology, flexible inspection Systems, Material Handling systems, Computer control Systems, Benefits of Computer Integrated Manufacturing System.

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COURSE CONTENT: MECHANICAL ENGINEERING

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

1. **Identify** the main elements in computer integrated manufacturing systems.
2. **Apply** knowledge of computer aided process planning, feature and group technology, and data exchange in manufacturing processes.
3. **State** the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion;
4. **Prepare** product models with CAM tools and CNC machines.
5. **Explain** knowledge about Computer Aided Quality control and Process Planning Control.
6. **Design** Flexible manufacturing cell after carrying out Group technology study and finally creating FMS.

Text & References Books:

- Radhakrishnan, P., "Computer Integrated Manufacturing", PSG Collage of Technology Coimbatore.
- Eric Teichols and Joel Orr, "Computer Integrated Manufacturing Hand Book", Mc Graw Hill Book Co.
- Paul, G.Ranky, "Computer Integrated Manufacturing..

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-603: Power Plant Engineering

Category	Title	Code	Credit-4			Theory Paper
Elective-II	Power Plant Engineering	BMEL-603	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	0	

Course Objectives: To make the students to understand:

1. To teach students about the working of various power generation units and steam cycles.
2. To introduce students to steam generators, combustion and firing methods in order to make the fullest use of thermal power potentialities of the country.
3. To enable students understand in detail about nuclear, gas turbine, hydro and diesel power plants which play an important role in power generation.

Syllabus

UNIT-I INTRODUCTION:
Review of World and Indian energy situation in respect of demand, supply for year 20/2 and resources in the historic context. Generalized energy conversion system. Primary and secondary energy sources their inter convertibility. Introduction Direct conversion methods.

UNIT-II FOSSIL FUEL STEAM STATIONS:
Basic principles of setting and station design. Effect of climatic factors to station and equipment design. Choice of steam cycle and main equipment, recent trends in turbines and boiler sizes and steam conditions. Plant design and layout. Outdoor and plant system components. Fuel handling, burning systems, element of feed water treatment plant condensing plant and circulating water systems. Cooling towers. Turbine room and auxiliary plant component Instrumentation, testing and plant, heat balance.

UNIT-III NUCLEAR POWER STATION:
Importance of nuclear power development in the world and Indian Review of atomic structure and ratio activity Bonding energy concept. Fission and fusion . Fissonable and coolants their relative merits. Heterogeneous Control reactor systems. Fast and thermal Review of Indian nuclear energy programme.

UNIT-IV HYDRO-POWER STATION:
Elements of Hydrological computations. Rainfall run off. Flows and power duration curves, mass curves, storage capacity . Salient features of various types of hydel stations. General discussion on hydel station, component such as dams, spillways, Intake systems, headworks, flumes, pressure tunncls, penstocks, Reservoir, balancing reservoirs etc. selection of hydraulic turbines for power staion duty, selection of site.
Solar thermal power plant- Introduction and principle , solar tower power station , parabolic trough power plant, dish/stirling system, solar up draught tower power plant, solar pond power plant.

UNIT-V POWER STATION ECONOMICS:
Estimation and prediction of load, Maximum demand, Load factor, Diversity factor, Plant factor etc. and their influence on plant design, Operation and economics principles, principles of Hydro and Nuclear Power plant, Typical cost structure. Different types of tariffs. Simple problems on cost analsis, economic performance and tariffs. Inerconnected system: Their advantages. Elements of load dispatch in interconnected systems. Review of power development in India.

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COURSE CONTENT: MECHANICAL ENGINEERING

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

1. **Describe** the power situation in India. **Learn** about various types of power plants and how they produce power
2. **Identify** methods of producing power based on different classifications, and their the selection criterion of power plants.
3. **Apply** the usage of power tariff calculation, **calculating** tariffs, **understand** the economics of power plant
4. **Compare** various types of producing power, advantages and disadvantages of different types of power plants
5. **Calculate** the efficiencies of various power plant.
6. **Exhibit** the detailed knowledge gained by **drawing** various types of arrangements of power plants and **explain** the working of each part of the same

Text & References Books:

1. P. K. Nag, Power Plant Engineering: Steam and Nuclear, Tata McGraw-Hill Publishing Company Ltd., Second Edition.
2. M. M. El-Wakil, Power Plant Technology, McGraw-Hill International Editions
3. Black and Veatch, Power Plant Engineering, CBS Pub and Distributors, New Delhi.
4. R. K. Rajput, A Text Book of Power Plant Engineering, Laxmi Publications (P) Ltd.

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COURSE CONTENT: MECHANICAL ENGINEERING

Unconventional Machining Process

Category	Title	Code	Credit-4			Theory Paper
Elective-II	Unconventional Machining Process	----------	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	--	

Course objectives: To make the student to understand:

1. The basic understanding of unconventional machining processes
2. The principle, mechanism of metal removal of various unconventional Machining processes
3. 3D laser forming, parametric analysis for performance evaluation
4. Concept of MRR, feed rate and new hybrid non-traditional processes
5. The various process parameters and their effect on the component machined on unconventional machining processes

Syllabus

Unit-I Modern Manufacturing Methods: - Unconventional machining Process – Need – classification – Brief overview, Considerations in process selection, materials, applications, Brief description of High-Energy Rate Forming (HERF) processes. Hybrid processes.

Unit-II Mechanical Energy Based Processes:-

Abrasive Jet Machining: Principle of Working, AJM setup, Gas propulsion, Abrasive Feeder, Machining chamber and nozzle, Parameter analysis for performance evaluation, Process capabilities, advantages, Limitations and Applications.

Principle of working, USM System, Mechanics of Cutting, Parametric Analysis, Process capabilities, Advantages, Limitations and Applications. Working principle and applications of Water Jet Cutting (WJC), and Abrasive Water Jet Machining (AWJM), Abrasive Polishing and Hydraulic Jet Cutting, Abrasive Flow Machining (AFM), Magnetic Abrasive Machining (MAM),.

Unit-III Electrical Energy Based Processes:-

Electric Discharge Machining (EDM)- working Principle- equipment's -Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM-Applications

Unit –IV Chemical and Electro-chemical Based Processes:-

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH – Applications.

Unit-V Thermal Energy based Processes:-

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

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

1. **Define** the principles of various unconventional machining processes.
2. **Explain** the applications and limitations of various unconventional machining processes.
3. **Identify** the process parameters of machine.
4. **Apply** parametric analysis for performance evaluation.
5. **Analyze** the parameters for material removal in unconventional machining processes.
6. **Develop** the model for optimization of process parameters.

Text & References Books:

1. Advance Methods of Machining by M G Gough, J.A, Chapmanand Hal London.
2. Non-traditional Manufacturing Process Engineering by Gray F. Bendictm, MARCAL, DEKK.ER Inc.
3. Modern Manufacturing Process Engineering by Niebe, Mc.Graw-Hill Int. Ed.
4. New Technology by Bhattacharya, A.IE (I) Calcutta.
5. Non-conventional Machining by Mishra, PK Narosa Publishing House, New Delhi.
6. Modern Machining Methods by Adithan, S.Chand & Co. New Delhi.
7. Modern Machining process by Pandey, PC and Shan, HS Tata Me Graw Hill, New Delhi.
8. Manufacturing Science by Ghose, A & Malik, AK, EWP.
9. Production Technology by HMT.
10. Fundamentals of Machining and Machine Tools by Boothroyed Marcel, Dekker, Inc.
11. ASM Metals Handbook, Vol. Number Machining.
12. Production Technology by PC Sharma, S. Chand & Company Ltd.

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COURSE CONTENT: MECHANICAL ENGINEERING

Fracture Mechanics

Category	Title	Code	Credit-3			Theory Paper
Elective- II	Fracture Mechanics	----------	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives:

1. Applies analysis to members subjected to axial, bending, and tensional loads and calculate stresses and deformations of objects under external loadings.
2. To analyze and understand principal stresses due to the combination of two dimensional stresses on an element and failure mechanisms in materials.
3. To familiarize the students with Mechanics of fracture, general yielding fracture mechanics, fracture safe design and fractured surfaces.

Syllabus

UNIT-I

Introduction: Inter-disciplinary approaches in fracture mechanics, modes of deformation and failure

UNIT-II

Linear Elastic Fracture Mechanics: Stress concentration in the vicinity of notches and cracks, Griffith's energy concept, Irwin's stress intensity approach, fracture toughness

UNIT-III

General Yielding Fracture Mechanics: Crack tip plastic zones, Wall's crack opening displacement concept, J-integral

UNIT-IV

Evaluation of Fracture Mechanics Parameters: Plane strain fracture toughness testing i.e., KIC

UNIT-V

Micro Structure and Fracture Toughness: Physical significance of fracture toughness in relation to microstructure, principles for the development of fracture resistant materials

UNIT-VI

Fracture Safe Design Principles: Leak before break Paris Law for fatigue crack growth.

Fractured surfaces: Acquaintance with some common fracture surfaces of various materials, like steels, C.I, non-ferrous alloys etc

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

1. **State** the different modes of failure.
2. **Describe** the behaviour of molecular structure of material with variation of temperature
3. **Differentiate** elastic and plastic behaviour of the material.
4. **Predict** the life of the component.
5. **Identify** the crack propagation direction.
6. **Design** the component on the basis of fracture toughness.

Text /Reference Books:

1. Prashant Kumar; 'Elements of Fracture Mechanics"; Publisher- Tata McGraw- Hill Publishing Company Limited(ISBN 0070656967)

2. Knott.J.F; "Fundamentals of Fracture Mechanics", Publisher-John Wiley & Sons, Newyork(ISBN 0408705299)

3. Gdoutos.E.E; "Fracture Mechanics- An introduction"; Publisher-Springer (ISBN 9401581584)

4. Ramesh.K; "e-Book on Engineering Fracture Mechanics"; IIT Madras (ISBN: 978-81-904235-0-2)

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-604: Operation Research and Supply Chain

Category	Title	Code	Credit-5			Theory Paper
			L	T	P	
Departmental Core-DC	Operation Research and Supply Chain	BMEL-604	3	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. Effective written and oral communication skills to business situations.
2. The global business environment.
3. The local business environment.
4. Critical thinking skills in business situations.
5. Ethical understanding and perspective to business situations.

Syllabus

UNIT -I LINEAR SYSTEM AND DISTRIBUTION MODELS:

Introduction, development & application, Linear programming formulation, Graphical solution, Simplex Method, Transportation problem, Distribution method, MODI & Vogel's approximate method, Assignment model use of SW Lindo, Tora, Excel.

UNIT - II WAITING LINE MODELS:

Introduction, Input process, service mechanism, models with Poisson arrival & exponential service. Queue discipline, single server (M/M/1) average length and times by Little's formula, optimum service rate; basic multiple server models (M/M/s).

Replacement theory: Introduction, equipment replacement, capacity correction, replacement with changing money value, group replacement.

UNIT - III INVENTORY MODELS:

Necessity of inventory in process and safety stock, problem of excess inventory and cycle time (=WIP/ Throughput), basic EOQ/ EPQ models for constant review Q-system(S,s); periodic review, base stock P-system; service level, lead time variance and safety stock;; ABC, VED and other analysis based on shelf life, movement, size.

UNIT - IV NETWORK ANALYSIS:

CPM, PERT, probability of expected project duration, crashing of activities, cost analysis

DECISION ANALYSIS:

Decision under certainty, risk probability and uncertainty; Hurwicz criteria; AHP- assigning weight and consistency test of AHP.

UNIT -V SUPPLY CHAIN (SCM):

Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and leadership issues; change of purchasing role and vendor rating, variability from multiple suppliers.

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

1. **State** the supply chain rules in industry.
2. **Choose** the decision theory for industry.
3. **Analyze** the manufacturing operations of a firm.
4. **Discuss** sales and operations planning, MRP and lean manufacturing concepts.
5. **Improve** supply chain operations by applying logistics and purchasing concepts.
6. **Apply** quality management tools for process improvement.

Text & References Books:

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH
2. Simchi-Levi, Keminsky; Designing and managing the supply chain; TMH.
3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning
4. Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India

5. Taha H; Operations research; PHI
6. Sen RP; Operations Research-Algorithms and Applications; PHI Learning
7. Ravindran , Philips and Solberg; Operations research; Wiley India
8. Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.
9. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain Logisti Mgt; TMH
10. Burt DN, Dobler DW, StarlingSL; World Class SCM; TMH
11. Bronson R ;Theory and problems of OR; Schaum Series; TMH

List of Experiments:

Hands on practice on lingo etc. software for solving the problem of linear programming, assignment, and transportation problem.

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-605: Turbo Machinery

Category	Title	Code	Credit-5			Theory Paper
Departmental Core-DC	Turbo Machinery	BMEL-605	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	2	

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.
3. To introduce students to fans, turbines, pumps etc.

Prerequisite: Basic concepts of Fluid Mechanics

Syllabus

UNIT-I INTRODUCTION:
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-I 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 work done Draft Tubes, governing or water turbines.

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 machines cavitations.

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:

1. **Relate** analytical problems in turbo-machines for both compressible and incompressible fluid flows.
2. **Demonstrate** the knowledge of working, stages, performance characteristics, governing and selection of turbo-machinery.
3. **Recognize** typical designs of turbo machines.
4. **Determine** the velocity triangles in turbo machinery stages operating at design and off-design Conditions.
5. **Explain** and understand how the flow varies downstream of a turbo machinery blade row.
6. **Analyze** the limitation and working of steam turbine and apply the principle moment of momentum

equation.

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-606: Dynamics of Machines

Category	Title	Code	Credit-5			Theory Paper
			L	T	P	
Departmental Core-DC	Dynamics of Machines	BMEL-606	3	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. Analysis of forces acting in mechanisms.
2. Effects of unbalance forces
3. The principles in mechanisms used for governing of machines
4. Drawing the profile of cams and its analysis
5. Gear train calculation, gyroscopes

Syllabus

UNIT- I GEAR:

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

UNIT-III BALANCING:

Introduction, Balancing of rotating masses, Locomotive balancing. Balancing of multicylinder in line engines. Balancing of radial engines. Direct and reverse crank method of balancing.

UNIT-IV SYNTHESIS OF LINKAGES :

Introduction. Type, 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.

UNIT-V 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.

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

1. **State** the forces acting on various linkages when a mechanism is subjected to external forces.
2. **Identify** and correct the unbalances of rotating body.
3. **Determine** dimensions of Governors for speed control.
4. **Calculate** gyroscopic couple on various vehicles.
5. **Classify** cam mechanism and cam motion profiles.
6. **Analyze** gear mechanism classification and gear train.

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COURSE CONTENT: MECHANICAL ENGINEERING

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 .

List of experiments

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

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COURSE CONTENT: MECHANICAL ENGINEERING

Course of study and Scheme of Examination (Grading system, w.e.f. July2017)

B.E. VII Semester (Mechanical Engineering)

S. No.	Subject Code	Subject Name & Title	Maximum Marks Allotted						Credit Allotted Subject wise			Total credits	Remarks
			Theory Slot			Practical Slot		Total Marks	Period per week				
									L	T	P		
			End Sem.	Mid Sem	Quiz Assignment	End Sem.	Term Work / Lab Work & Sessional						
1.	BMEL -701	Machine Design-III	70	20	10	30	20	150	3	1	2	5	
2.	BMEL -702	Refrigeration & Air- Conditioning	70	20	10	30	20	150	3	1	2	5	
3.	BMEL -703	Robotics & Mechatronics	70	20	10	--	--	100	3	1	--	4	
4.	BMEL-704	Heat & Mass Transfer	70	20	10	30	20	150	3	1	2	5	
5.	BMEL -705	Elective-III: (i) Production & Operation & Management	70	20	10	--	--	100	3	1	--	4	
		Elective-III: (ii) Gas Dynamics											
		Elective-III: (iii) Material Handling systems and Equipment											
		Elective-III: (iv) Non-conventional energy sources											
		Elective-III: (v) Machine Tool Technology											
6.	BMET -706	Industrial Training	--	--	--	--	50	50	-	-	2	1	
7.	BMED - 707	Project-I	--	--	--	60	40	100	-	-	4	2	Grand Total
Total			350	100	50	150	150	800	15	5	12	26	800

L: Lecture T: Tutorial P: Practical01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-701: Machine Design - III

Category	Title	Code	Credit-5			Theory Paper
			L	T	P	Max.Marks-70 Min.Marks-22
Departmental Core	Machine Design - III	BMEL-701	3	1	2	Duration-3hrs.

Course Objectives: To make the students:

1. Apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
2. Illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
3. Apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems like Bearings and shaft selection.
4. Apply computer based techniques in the analysis, design and/or selection of machine components.
5. Develop an appreciation for engineering design through the disassembly and examination of existing products.

Syllabus

UNIT-I Reliability: Reliability, Probability, MTBF, MTTF, Failure density, Hazards Rate. Series, Parallel and Mixed configuration. **Product Design**: Product initiation, Market Survey, Creativity in design, alternative design, Aesthetics form. Optimization in design.

UNIT-II Fracture: Design against Fracture, Stress intensity factor of a crack for finite bodies, Fracture criteria, fracture toughness, plastic deformation around a crack tip, crack opening phenomenon. **Creep:** Creep phenomenon, Creep parameters, stress relaxation.

UNIT-III Sliding Contact Bearings: Bearing Classification, Selection of bearing, Viscosity of Lubricants, Bearing Materials, Types of sliding contact bearing, Petroff's relation for Power Loss, loads on bearing, Design of Journal bearing, Advantages, Disadvantages, Limitations, Heat Dissipation.

UNIT-IV Rolling Contact Bearings: Designation, Types of Rolling contact bearing, Friction effect in Rolling bearing, loads on bearing, Fatigue, Deflection & deformation in bearings, Selection of bearing and bearing life.

UNIT V Tribological consideration: Wear, Types of wear, Wear resistant materials, Methods of Testing, Friction, Lubrication, Methods of lubrication, Lubricants, Classification, Application. Introduction of Reverse Engineering, Rapid Prototyping. Mechatronics, Artificial Intelligence and Concurrent Engineering

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

1. **State** their basic knowledge of Reverse Engineering, Rapid Prototyping, Mechatronics and AI.
2. **Document** and **justify** their designed component.
3. **Implement** computer aided design to simulate problems.
4. **Apply** their knowledge in various tribological conditions.
5. **Demonstrate** knowledge of basic physics and engineering analysis to their designs.
6. **Design** sliding and rolling contact bearings under various loading conditions.

NOTE: Sessional Work shall consist of Class work / homework, minimum 5 Drawing Sheets/ Computer Graphics of above mentioned machine parts and design problems. Use of design data book is permitted

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COURSE CONTENT: MECHANICAL ENGINEERING

Text & References Books:

1. Engineering Design **by** George Dieter **of** MGH New York
2. Product Design and Manufacturing **by** A.K. Chitale & R.C. Gupta **of** PHI
3. Design of Machine Elements **by** V.B. Bhandari **of** Tata McGraw Hill
4. Machine Design **by** S.G. Kulkarini **of** Tata McGraw Hill

LIST OF EXPERIMENTS:

1. Study of Sliding Contact Bearings and its selection
2. Study of Ball bearing and its selection
3. Design of Antifriction Bearing
4. Design of Journal Bearing
5. Write a computer program based on above exercise.
6. Assembly drawing of the Foot step bearing.
7. Assembly drawing of the Stuffing Box.
8. Four problems on design of Bearings.
9. Modelling of 2-D and 3-D Drawings using CAD Software

BMEL-702: Refrigeration & Air Conditioning

Category	Title	Code	Credit-5			Theory Paper
Departmental Core-DC	Refrigeration & Air Conditioning	BMEL-702	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	2	

Course Objective: To make the students to understand:

1. The importance of refrigeration techniques in the day-to-day life and to study the basic processes such as VARS, VCRS etc.
2. The engineering principles of thermodynamics and refrigeration techniques.
3. To identify, analyze, and solve problems related to VARS, VCRS, Air-craft refrigeration cycles.
4. The theoretical and practical skills needed to develop their future professional activity in the areas of thermal and refrigeration techniques.
5. To know about the loading conditions and psychometric properties.

Syllabus

Unit-I: Carnot Cycle:

Reversed Brayton Cycle Coleman Cycle. Air Cycles for Aircraft Refrigeration, Ranquehiloch Tube. Properties Requirement, & Applications of Refrigerants. CFC & HFC Refrigerants. Simple vapour Absorption Systems-Electrolux Refrigerator, Refrigerants, Zone depleting refrigerants.

Unit-II: Vapour Compression System:

Simple Systems, Multi pressure systems. Compound Compression, Multi Evaporator Systems. Cascade Systems. Vapour absorption system. Double vapour absorption cycle.

Unit-III: Refrigerant Compressor:

Condensers. Expansion Devices. Evaporators, Liquification of Gases. Requirements of Air Conditioning. Properties of Moist Air, Psychrometric chart, Psychometric Processes.

Unit-IV: Summer Air Conditioning:

Winter Air Conditioning. Design Conditions-Choice of inside Design Conditions. Comfort. Outside Design Conditions, Choice of Supply Design Conditions, Critical Loading Conditions, Load Calculations & Applied Psychometric.

Unit-V: Transmission & Distribution of Air:

Refrigeration and Air conditioning control.

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

1. **State** the basic concepts of refrigeration and air conditioning systems.
2. **Analysis** of various refrigeration cycles.
3. **Calculate** psychometric properties and process.
4. **Analyze** heating and cooling load requirements of a room.
5. **Apply** scientific and engineering principles to analyze the design aspects of engineering systems that relate to refrigeration and air conditioning.
6. **Select** the suitable refrigeration cycle as per cooling requirement.

Text & Reference books:

1. Refrigeration and Air Conditioning by C.P. Arora; PHI
2. Refrigeration and Air Conditioning by Ramesh Chandra

List of Experiments (Expandable):

1. Demonstration of fundamental study of Absorption Refrigeration System. * Performance of Ice-Candy unit.
2. Demonstration of C.O.P. and Performance of Air-Conditioner.
3. Demonstration of fundamental study of Vapour Compression cycle (Ice candy Unit0
4. Determination of C.O.P. in Vapour compression Refrigeration system.
5. Demonstration of Electrolux Refrigerator. * Demonstration Tushar Water Cooler.
6. Equipment and controls of Refrigeration System. * Equipment and controls of Air Conditioning System.
7. Demonstration of C.O.P. and other performance parameters for Mech. Heat Pump.
8. Demonstration of C.O.P. and other performance parameters for Mech. Heat Pump.

BMEL-703: Robotics & Mechatronics

Category	Title	Code	Credit-4			Theory Paper
Departmental Core	Robotics & Mechatronics	BMEL-703	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives: To make the students to understand:

1. Study and understand the concepts of Robotics & 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 PID controllers.

Syllabus

Unit-I: Introduction to robotics: brief history, types, classification and usage and the science andtechnology of robots,Physical configurations, actuators and motion control; Terminologies used for robotics specification, robot vision,sensors, types of end effectors.

Unit-II: **Robot Kinematics and Dynamics:** direct and inverse kinematics problems and workspace, inverse kinematics solution for the general 6R manipulator, redundant and over-constrained manipulators.Introduction to Robot Dynamics

Unit-III: Planning and control: Trajectory planning, position control, force control, Robot programing methods, hybrid control Industrial and medical robotics: application in manufacturing processes, e.g. casting, welding, painting,machining, heat treatment and nuclear power stations, etc. **Advanced topics in robotics:** Modelling and control of flexible manipulators, wheeled mobile robots etc. Future of robotics.

Unit-IV: Introduction: Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach.Review of fundamentals of electronics. Data conversion devices, sensors,microsensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs

Unit-V: Actuators: Mechanical Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor,Hydraulic & Pneumatic Actuation Systems. Design of hydraulic circuits. Description of PID controllers. Simulation of systems in software (MATLAB, LabVIEW) environment.

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

1. **State** the basics of robot kinematics and trajectory planning.
2. **Discuss** the requirements from robotic work cell controller and its programming,
3. **Formulate** robotic manipulator to work in an integrated automated industrial environment
4. **Demonstrate** the concepts of mechatronics systems.
5. **Implement** mechanical and electrical actuation systems, for analyzing measurement systems.
6. **Utilize** simulation softwares in future courses like project work in summer training, project semester, mechatronic system design etc.

Text & References Books:

1. 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.
2. Introduction to Robotics **by** S. K. Saha **of** Tata McGraw-Hill Publishing Company Ltd.
3. Introduction to Robotics–Analysis Systems, Applications **by** S. B. Niku of Pearson Education
4. Robotics:Fundamental Concepts and Analysis **by** A. Ghosal of Oxford University Press.
5. Mechatronic Systems: Fundamentals **by** R. Iserman of Springer
6. Fundamentals of Mechatronics **by** Musa Jouaneh of Cengage Learning.
7. System Simulation **by** G. Gordon of, PHI Learning.
8. Micromechatronics, Modeling, Analysis, and Design with MATLAB **by** V. Giurgiutiu and S. E. Lyshevski, CRC Press.

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-704: Heat and Mass Transfer

Category	Title	Code	Credit-5			Theory Paper
			L	T	P	
Departmental Core	Heat and Mass Transfer	BMEL-704	3	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objectives: To make the students to understand:

1. Study of Comprehensive, theory based understanding of physical science and its fundamentals applicable to the engineering discipline of heat and mass transfer.
2. To understand the fundamentals of heat transfer mechanisms in fluids and solids.
3. Formulation and solving problems of heat transfer related to applications of conduction, convection and radiation heat transfer.
4. Understand role and application of dimension less numbers in heat transfer.
5. Learn applications of heat transfer in various equipment's in process industries.

Syllabus

UNIT-I Introduction: to 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's Theory. 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 CONTENT: MECHANICAL ENGINEERING

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

1. **State** principles of heat and mass transfer to basic engineering systems
2. **Develop** basic concepts of heat transfer, differentiate between heat transfer and thermodynamics, modes of heat transfer (rates) i.e. Conduction, Radiation and convection.
3. **Analyze** and **solve** heat transfer problem of conduction, convection and radiation
4. **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
5. **Formulate** and **solve** one dimensional conduction with and without heat generation, convection and radiation heat transfer problems.
6. **Create** solution techniques which include both closed form and numerical methods of heat conduction and Convection.

Text & References Books:

1. Heat & Mass Transfer **by** Dr. D S Kumar
2. A course in Heat & Mass Transfer **by** Arora & Domkundwar
3. Heat Transfer **by** P K Nag
4. Heat Transfer **by** J P Holman **of** McGrawhill
5. Heat Transfer **by** James Sucec
6. Principles of Heat Transfer **by** Kreith & Bohn
7. Heat and Mass Transfer **by** Yunus A. Cengel **of** TMH
8. Heat and Mass Transfer **by** M. Thirumaleshwer **of** 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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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-705(i): Production and Operation Management

Category	Title	Code	Credit-4			Theory Paper
Elective-III	Production and Operation Management	BMEL-705(i)	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objective: To make the student to understand:

1. The role of operations management in the overall business strategy of the firm
2. Principles and applications relevant to the planning, design, and operations of manufacturing firms
3. How Enterprise Resource Planning and MRPII systems are used in managing operations
4. Layout planning, assembly line balancing and Inventory control system
5. The application of operations management policies and techniques to the service sector as well as manufacturing firms

Syllabus

Unit-I Production Management: Operation Management System, Concept, Objectives, Decisions. Types of Production System Life Concept. Role of Scientific Methods. History. Forecasting Techniques, Product Design Research, Development, Product Selection Process. **Transformation Process:** Location Facilities, Subjective Qualitative Semi Quantitative Techniques, Break Even Analysis. Layout of Facilities. Material Handling System, Design.

Unit-II Intermittent Flow Process: Job Production, Problem, Sequencing Job Scheduling. Problem & Prospects of Job Production Johnson Rule. **Batch Production:** Application of L.P. to Aggregates Production Planning. Problems & Prospects of Batch Production Management of Materials in Production System. MRP Process Line of Balancing.

Unit-III Contnnes Flow Process: Reasons for Mass Production. Assembly Line Balancing Problems & Prospects of Mass Production.

Unit-IV Probability & Statistics: Probabilistic Models in Inventory Control Maintenance Spares Management Different Types of Maintenance Queuing Theory . Application to Maintenance. Finite Source. Queuing Theory for Maintenance. Maintainability Maintenance Policy.

Unit-V Purchase Management: Bayesian Analysis, Learning Curves. Vendor Rating, Stores Management, Standardization. Condification, Varity Reduction- Waste Elimination Method. Project Appraisal Methods.

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

1. **Identify** the inputs, transformation processes and outputs of an organization**.**
2. **Describe** the boundaries of an operations system, and recognize its interfaces with other functional areas within the organization and with its external environment.
3. **Apply** core features of the operations and production management function at the operational and strategic levels, specifically the relationships between people, process, technology productivity and quality.
4. **Discuss** Forecasting technique and layout planning.
5. **Analyze** the Inventory models and job shop models in Industries.
6. **Evaluate** approaches to solve problems and improvement the process.

Text & References Books:

1. G. Free-Bell and J Balkwill. Management in Engineering. Prentice-Hall of India (P) Ltd, New Delhi, Second edition.
2. E S Buffa and Sareen Production and Operations Management. New Age International (P) Ltd. New Delhi.
3. W J Sivanesan Production/Operations Management. Richard D Irwin Inc.
4. J L Riggs. Production Systems: Planning Analysis and Control. John Wiley & sons New York, forth edition.

BMEL-705(ii): Gas Dynamics

Category	Title	Code	Credit-4			Theory Paper
Elective-III	Gas Dynamics	BMEL-705(ii)	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives: To make the student to understand:

1. The basic concepts and results for the compressible flow of gases and introduction to the numerical method of characteristics.
2. The basic concepts of Jet and rocket propulsion.

Syllabus

UNIT I: FUNDAMENTALS OF COMPRESSIBLE FLOW: Compressible fluid flow-energy and momentum equations, stagnation stages, various regions of flow, reference velocities, effect of Mach number on compressibility. Types of waves, Mach cone, Mach angle.

UNIT II: FLOW THROUGH DUCTS: Flow through variable area ducts-nozzles and diffusers, Mach number variation, stagnation and critical states, area ratio as a function of Mach number. Flow through constant area ducts-with friction (Fanno flow), with heat transfer (Rayleigh flow), Variation of flow properties. Use of Gas Tables and Charts.

UNIT III: NORMAL AND OBLIQUE SHOCKS: Governing equations, variation of flow parameters across the normal and oblique shocks. Prandtl Meyer relations. Flow in variable area ducts with normal shocks. Use of Tables and Charts.

UNIT IV: JET PROPULSION: Types of jet engines-turboprop, turbojet, ramjet, pulsejet. Aircraft propulsion theory, performance analysis of jet engines, parameters affecting flight performance, thrust augmentation.

UNIT V: ROCKET PROPULSION: Types of rocket engines, propellants, combustion instabilities, rocket propulsion theory, performance of rocket engine, multistage rockets, orbital and escape velocities

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

1. **Define** compressible flow through ducts, jet propulsion and space propulsion.
2. **Discuss** rocket propulsion and types of rocket engine.
3. **Classify** basic difference between incompressible and compressible flow.
4. **Apply** phenomenon of shock waves and its effect on flow.
5. **Correlate** Gas Dynamics with various mechanical systems.
6. **Develop** the understanding the Behaviour of Gas under various conditions.

Text & References Books:

1. Fundamental of Compressible flow, S. M. Yahya, New age international Publication, Delhi
2. Fundamentals of compressible fluid dynamics- P. Balachandran, PHI Learning, New Delhi
3. The dynamics and thermodynamics of Compressible fluid low Volume-I, Ascher H. Shapiro, the Ronald Press Company, New York.
4. Gas Dynamics, E. Rathakrishnan, PHI Learning Pvt. Ltd
5. Gas Dynamics and Jet Propulsion- P. Murugaperumal, Scitech Publication, Chennai.
6. Modern Compressible Flow: With Historical Perspective, John D. Anderson, McGraw-Hill Higher Education

BMEL-705(iii): Material Handling systems and Equipment

Category	Title	Code	Credit-4			Theory Paper
Elective-III	Material Handling systems and Equipment	BMEL-705(iii)	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives: To make the student to understand:

1. basic understanding of material handling facilities and the fundamental principles of material handling;
2. quantitative techniques for designing warehouse and material handling systems and an understanding of their limitations;
3. An understanding of safety issues and regulations in warehouse and material handling.

Syllabus

Unit-I Elements of Material Handling System-Importance, Terminology, Objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and plant layout, physical facilities and other organizational functions; Classification of Material Handling Equipment.

Unit-II Selection of Material Handling Equipment-Factors affecting for selection; Material Handling Equation; Choices of Material Handling Equipment; General analysis Procedures; Basic Analytical techniques; The unit load concept; Selection of suitable types of systems for applications ; Activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials.

Unit-III Materials Handling: Study of the Principles and Inportance of Materials Handling, Analysis of Handling. Analysis of Materials. Handling Problems. Operation and Flow Processes. Using Predetermined Data in Analysis. Design of Mechanical Handling Equipment- Design of Hoists, Drives for hoisting, components, and hoisting mechanisms; rail travelling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms.Design of Cranes, Hand-propelled and electrically driven E.O.T. overheat Travelling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary cranes with fixed radius ; fixed post and overhead travelling cranes; Stability of stationary rotary and travelling rotary cranes.

Unit-IV Design of load lifting attachments- Load chains and types of ropes used in Material Handling System; Forged, Standard and Ramshorn Hooks; Crane Grabs and Clamps; Grab Buckets; Electromagnet; Design consideration for conveyor belts; Application of attachments.

Unit-V Study of systems and Equipment used for Material Storage- Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors; Bucket-elevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks etc. Material Handling / Warehouse Automation and Safety considerations-Storage and warehouse planning and design; computerized warehouse planning; Need, Factors and Indicators for consideration in warehouse automation; which function, when and How to automate; Levels and Means of Mechanizations. Safety and design; Safety regulations and discipline.

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COURSE CONTENT: MECHANICAL ENGINEERING

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

1. **State** fundamental principles of material handling systems.
2. **Select** appropriate equipment for material handling and understand the basic roles of the different equipment.
3. **Apply** appropriate techniques for improving existing material handling systems.
4. **Recognize** the importance of safety issues in the areas of warehouse and material handling.
5. **Compare** procedures for the study of different material handling equipment.
6. **Improve** presentation and team work skills.

Text & References Books:

1. N. Rudenko, „Material Handling Equipments", Peace Publishers, Moscow.
2. James M. Apple, „Material Handling System Design", John-Willlwy and Sons Publication, New York.
3. John R. Immer, „Material Handling" McGraw Hill Co. Ltd., New York.
4. Colin Hardi, „Material Handling in Machine Shops". Machinery Publication Co. Ltd., London.
5. M .P. Nexandrn, „Material Handling Equipment", MIR Publication, Moscow.
6. C. R. Cock and J. Mason, „Bulk Solid Handling", Leonard Hill Publication Co. Ltd., U.S.A.
7. Spivakovsy, A.O. and Dyachkov, V.K., „Conveying Machines", Volumes I and II, MIR Publishers
8. Kulwiac R. A., Material Handling Hand Book", JohnWilly Publication, New York

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-705(iv): Non-Conventional Energy Sources

Category	Title	Code	Credit-4			Theory Paper
Elective-III	Non-Conventional Energy Sources	BMEL-705(iv)	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives: To make the students to understand:

1. To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
2. To illustrate to students the energy situation in India.
3. To teach students to apply methods of bio energy conversion in commonly used mechanical systems.
4. To teach students how to apply wind energy convertors in mechanical systems.
5. Help students develop an appreciation for engineering design through the solar energy concept.

Syllabus

UNIT-I Non-Conventional Energy Sources: General introduction to energy situation in India, types of non-conventional (renewable) energy sources, solar energy, wind energy, hydro energy, tidal and wave energy, nuclear energy, bio energy, solar photovoltaic conversion, thermal energy conversion efficiency and limitations.

UNIT-II Solar Energy: Solar radiation distribution: Earth-Sun angles, time wall, solar azimuth angle, angle of incidence. Direct, diffuse and normal sky solar radiation on the surface. Heat gain through glass shading and greenhouse effect. Solar energy utilization: Solar collector, solar water heating, solar cooling, solar water distillation and other applications.

UNIT-III Nuclear Energy: Generation of nuclear energy by fission and fusion. Role of enrichment and heavy water in neutron, chain reaction, economy and reactor safety aspect, radioactive disposal.

UNIT-IV Photovoltaic Energy: Solar cell, modules, equivalent circuit diagrams of a solar cell, silicon solar cell, solar photovoltaic systems and efficiency. **Bio Energy:** Biomass, methods of bio energy conversion. Biological method of bioconversion Ethanol, production. Bio gas plant.

UNIT V Wind Energy: Wind direction, wind measurement. Wind energy converters, types of wind mills. Power coefficient. Rotodynamic construction of rotor blade. Micro generation wind turbines.

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

1. **State** basic concepts of various non-conventional sources of energy like wind, biomass etc. and its applications in remote areas of the country.
2. **Discuss** the importance of energy scenario.
3. **Apply** principles of solar energy to basic engineering systems.
4. **Explain** working criteria of various direct energy conversion systems and study its applications.
5. **Compare** other direct energy conversion systems like thermoelectric and fuel cells.
6. **Evaluate** methods for generation of hydrogen power and production of hydrogen.

Text & References Books:

1. Non-Conventional Energy Sources **by** G N Tiwari **of** Nova Pub.
2. Solar Energy **by** S P Sukhatme **of** TMH
3. Nonconventional Energy Sources **by** G D Rai **of** Standard Publishers Distributors

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-705(v): Machine Tool Technology

Category	Title	Code	Credit-4			Theory Paper
Elective-III	Machine Tool Technology	BMEL-705(v)	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives: To make the students to understand:

1. Safe work habits that reflect concern and care for self, others and the environment.
2. Industry related mathematics and blueprint reading to job related applications.
3. Industry standards of tolerance and finish using manual machine tools.
4. Industry standards of tolerance and finish using computer numerical controlled (CNC) machine tools.

Syllabus

Unit-I Basic Concepts: Analysis and determination of forces acting on cutting tool and power consumption in the machine tool while performing various operations like Turning, Milling, cylindrical Grinding Drilling etc.

Unit-II Kinematics of Machine Tools: Classification of various types of the machine tools drive, Requirment for layout of stepped drives, Ranges of Spindle speeds, Range ratio, Number of steps: Graphical representations of speeds, Structure of deviation diagrams, steps-less speed regulating Mechanical, Hydraulic and Electrical methods.

Unit-III Strength Rigidity and Vibration Characteristics of Machine Tools: Spindle unit, mounting of Spindles, Bearing layout Slide waysm Hydro-dynamic action in slide ways, Roller guids, and Hydro-statics slide bearings. Structural Design considerations, Static Flexibility Shapes of the structure, Joint deflection, Dependence of process capability on rigidity of machine tools, static compliance tools. Vibration characteristics of machine tools, Normal modes, Machine tool chatter, Theoretical Considerations: The Spindle work piece system, vibration in the Drilling Process, Fundamentals of Dumping, Semping of Machine tools.

Unit-IV Hydraulic systems of Machine Tools: General principles of hydraulic, drives, Fluid Power lines, pumps, Hydraulic cylinders and rotary motors and methods of their speed control. Hydraulic system components used in machine tools, Fluid amplifies, Introduction to hydraulic circuit design for machine tools.

Unit-V Numerically Controlled Machine Tools: Types of control, point to point positioning Continuous path control, Servo control Displacement feed back Increment, Absolute analogue information media feed and speed control.

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

1. **State** requirements for different machining operations.
2. **Apply** industry standard safety practices and specific safety.
3. **Calculate** necessary tolerances to plan for the machine sequences.
4. **Create** the digital geometry necessary for machine programming.
5. **Inspect** the produced part to ensure completion per blueprint requirement.
6. **Interpret** blueprint information and translate it into actionable items.

Text & References Books:

1. Mehta,N.K., Machine Tool Design, Tata McGraw Hill Book Co.
2. Macherkan, Machine Tools Design, Vol-I and Vol-III, Mir Publishers, Moscow.

Course of study and Scheme of Examination (Grading system, w.e.f. July2017)

B.E. VIII Semester (Mechanical Engineering)

S. No.	Subject Code	Subject Name & Title		Maximum Marks Allotted						Credit Allotted Subject wise			Total credits	Remarks
				Theory Slot			Practical Slot		Total Marks	Period per week				
										L	T	P		
				End Sem.	Mid Sem	Quiz Assignment	End Sem.	Term Work / Lab Work & Sessional						
1.	BMEL - 801	Vibration & Noise Control		70	20	10	30	20	150	3	1	2	5	
2.	BMEL - 802	Automobile Engineering		70	20	10	30	20	150	3	1	2	5	
3.	BMEL - 803	Statistical Quality Control/Statistical Process Control		70	20	10	30	20	150	3	1	2	5	
4.	BMEL - 804	Elective - IV	(i) Emerging Technologies & Management Techniques	70	20	10	--	--	100	3	1	--	4	
			(ii) Advance Welding Technology											
			(iii) Optimization Techniques											
			(iv) Maintenance Engineering											
			(v) Project Management											
5.	BMES -805	Seminar/Self Study		--	--	--	--	50	50	--	--	2	1	Grand Total
6.	BMED -806	Project-II		--	--	--	120	80	200	-	-	8	4	
Total				280	80	40	210	190	800	12	04	16	24	800

L: Lecture T: Tutorial P: Practical

01 Theory period: 01 Credit; 02 Practical Periods: 01 Credit

BMEL-801: Vibration and Noise Control

Category	Title	Code	Credit-5			Theory Paper
Departmental Core-DC	Vibration and Noise Control	BMEL-801	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	2	

Course Objective: To make the students to understand:

1. The basic fundamentals of vibration and noise control.
2. About the different types of vibrations and their DOF Systems.
3. About the vibrational properties of materials and their effects on various systems.
4. To design the components on the basis of vibration.
5. The fundamentals and concepts of Noise and Sound, IS codes and its importance in industrial areas.

Syllabus

Unit-I: Vibration Systems:

Introduction, Elements, Examples, SHM Principle of Super Imposition, Vector Representation Single DPF System. Degrees of Freedom, Equation of Motion-Energy Method and Newton's Law of Motion-General solution, Complimentary Function, Particular Integral, Rectilinear and Rotation System. Equivalent Stiffness of Springs, Logarithmic Decrement.

Unit-II: Single DOF Systems:

Single DOF Systems; Undamped, Damped Free Vibration, Undamped, Damped Forced Vibration with Harmonic, Excitation. Rotating and Reciprocating Unbalance. Critical Speed, Vibration Isolation and Transmissibility, Moving Supports, Seismic Instruments.

Unit-III: Two or More DOF Systems:

Introduction, Undamped Free Vibration, Principal Modes, Semi Definite System. Torsional System, Geared System Damped Dynamic Vibration Absorbers. Multi DOF System Numerical Methods. Influence Co-Efficient Matrix Rations Method, Holzer's Method, Stodola's Method. Dunker ley's Equations. Rayleigh Method.

Unit-IV: Continuous Systems:

Vibration of Strings. Longitudinal and Torsional Vibration of Uniform Rods. Transverse Vibration of Beams with Different End Conditions Elector Mechanical Analogy-Voltage-Force Analogy. Analogous Electrical Circuits. Calculation of Equivalent Electrical Elements for Simple Electrical Analogous Circuits. Introduction to Analog Computers.

Unit-V: Noise & Noise Control:

Sound, Noise Decibel Scale, Pressure and Density Level. Addition of Levels. Overall Noise from Different Frequency Ranges, Sound Level Meters. Perceived Noise Level. Traffic Noise Index. NC Curves, Building Acoustic, Effect of Noise on People, Noise Reduction, Noise Due to Industrial Equipment's. Important I.S. Codes Related to Noise.

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

1. **State** the fundamental concepts of noise, vibration and their measurement techniques.
2. **Discuss** the noise effect and their properties.
3. **Select** acoustical materials based on their absorption and transmission coefficients.
4. **Differentiate** the systems on the basis of DOF.
5. **Solve** the lumped mass problems of the isolated and linked systems.
6. **Determine** the various practices that can be incorporated to eliminate or increase the effect of vibration on a particular system.

Text & Reference books:

1. Vibration Problem Solving Companion by R.V. Dukkipatti
2. Engineering Vibration by William J. Bottega.

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-802: Automobile Engineering

Category	Title	Code	Credit-5			Theory Paper
Departmental Core-DC	Automobile Engineering	BMEL-802	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	2	

Course Objective: To make the students to understand**:**

1. To provide the basic concepts and principles of IC Engines.
2. To know the various fuel systems and their carburetion techniques.
3. To learn the basic concepts of transmission with modern torque drives.
4. To know about various types of chassis design and steering mechanism application in automobile.
5. To study about the various types of Ignition systems and distribution systems that are commonly use in commercial vehicles.

Syllabus

Unit-I: IC Engines:

Spark Ignition Engines. In-line, V and Opposed Types, Construction Type and Materials of cylinder Heads. Connecting Rods. Gudgeon Pins. Crank shafts, Piston Rings Bearings etc. Starting Systems.

Unit-II: Fuel Systems and Carburetion:

Gasoline, Aitovac and pressure Feed Systems. Diaphragm Pumps. Fitters and Fuel Gauges Carburetion function of Carburetor. Constant vacuum and static Types. Venturi and jet carburetion Engine Mixture Requirements. Compensatory Devices. Auxiliary Air Draught Carburetors. Diesel Fuel Feed Systems Fuel Pumps and their Calibrations. Injector and Testing Equipment's Governors.

Unit-III: Transmission Systems:

Clutches- Various Types. Dry and wet. Automatic and Centrifugal Fluid Fly Wheel Gear Boxes-sliding Mesh. Constant Mesh and Epicyclical Types. PIV Drive Drives-Hotchkish and Torque Drives. Front Axle Drive. Universal Joints. Differentials and Wheels Types.

Unit-IV: Chassis and Steering System:

Chassis Frames Rear and Front Axles. Camber and Toe in and Toe out. Steering system-Worm and Wheel Screw and Nut Cam and lever Type suspension & **Suspension system:** Spring Shock Absorbers. Front and Rear Mounting of Engines. **Brakes:** Brakes-mechanical Hydraulic Pneumatic.

Unit-V: Ignition and electrical system:

Battery its Charging and Care. Induction Circuit, Various Ignition systems. Cutout and Circuit Bracers. Starting and lighting systems. Lubrication & Cooling. Lubrication. Splash Pressure Feed and dry Pump. Selection of Lubricating oil. Crank Case Distribution: Filter & Pumps General Cooling. Heat Dissipation of Engines. Air water and Evaporative areas. Thermosyphon Pumps and Radiators.

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

1. **Identify** the type of engine and its application in different fields.
2. **State** the basic terminologies that are common in industry for fueling systems and carburetion techniques
3. **Differentiate** the various types of chassis and reasons of their applications, along with types of steering mechanisms and suspension systems like Mc Pherson, Trailing arm etc.
4. **Demonstrate** the electrical power systems and various ignition techniques.
5. **Compare** the various pumping systems and radiators.
6. **Design** the clutches on the basis of uniform pressure and wear theory and also will be able to know the actual mechanism of gearbox that are presently used in market.

Text & Reference books:

1. Automobile Engineering by NITTR-Bhopal (TMH)
2. Advanced Vehicle Technologies-Second Edition by Heinz Heisler.

BMEL-803: Statistical Quality Control/Statistical Process Control

Category	Title	Code	Credit-5			Theory Paper
			L	T	P	
Departmental Core-DC	Statistical Quality Control/Statistical Process Control	BMEL-803	3	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objective: To make the students to understand:

1. The concepts of inspection techniques.
2. The management of tally sheet and histogram.
3. About reliability, life testing and costing of product.
4. About the various methods of quality assurance like Taguchi, Ishikawa etc.
5. About the various standard and quality control organizations like ISO, BIS, RVC etc.

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:

1. **Draw** the histogram, bar charts.
2. **State** various techniques including various variable and attribute control charts as well as sampling plans, which are necessary skills for a quality professional.
3. **Relate** mathematical standard plots for defect analysis.
4. **Justify** the life cycle of component on the basis of Reliability and Quality.
5. **Compare** various statistical quality control tools.
6. **Solve** quality-related problems using these SQC tools and methods.

Text & Reference books:

1. Statistical Quality Control by Grant McGraw Hill, New York.
2. Statistical Quality Control by Mahajan and Mahajan
3. Statistical Quality Control by M. Jeya Chandra, CRC Press
4. Statistical Quality Control by Douglas C. Montgomery, John Wiley & Sons
5. Fundamentals of Quality Control and Improvement by Amitava Mitra, John Wiley & Sons

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-804(i): Emerging Technologies & Management Techniques

Category	Title	Code	Credit-4			Theory Paper
Elective IV	Emerging Technologies & Management Techniques	BMEL-804(i)	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objective : To make the students to understand:

1. The detailed concept of procurement, stock handling and inventory management.
2. About the ISO Standards
3. About TQM Standards
4. About automation techniques and methods used in modern manufacturing facilities.
5. The concepts of producibility and design for manufacturability.

Syllabus

Unit-I: Just in Time, Lean, Manufacturing, Maintainability, Information Technology

Unit-II: QFD, BPR, quality circle, Self-Managing Team, Bench Marking. Managing Change, Team Work.

Unit-III: Total Safety System: 5 –S concept, Occupational Health Hazards ISO 18001. Concurrent Engineering, Life Cycle Costing, Problem Solving.

Unit-IV: Standardization. Automation, Terotechnology, Producibility-Design for Manufacturability, Quality Leadership.

Unit-V: Value Added Management, Total Employees Involvement, Waste Management, ISO/4000 Designing of EMS, TQM Standards 10014, Design of Experiments.

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

1. **State** the concepts of ISO standards and their implementation areas.
2. **Explain** the quality standards that are commonly used in industry.
3. **Discuss** the modern manufacturing facilities.
4. **Perform** lifecycle analysis on respective design.
5. **Calculate** the automation requirement in conventional and non-conventional manufacturing facilities
6. **Create** an optimal relation between the order placement and inventory management.

Text & Reference books:

1. TQM By K.C. Arora
2. ISO 9000 to ISO 18001 by K.C. Arora

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-804 (ii): Advance Welding Technology

Category	Title	Code	Credit-4			Theory Paper
Elective-IV	Advance Welding Technology	BMEL-804(ii)	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives: To make the students:

1. To impart knowledge regarding various advanced welding practices in industries.
2. To understand the various parameters and requirements for welding processes.
3. To know the comparative merits and demerits of various welding processes.
4. To understand the right kind of welding technique suitable for various joints.
5. To learn about the joint designs adopted in different types of welding techniques.

Syllabus

UNIT I: Introduction to welding and joining processes

Introduction to consolidation processes, Classification of welding processes, some common concerns, types of fusion welds and types of joints, Design considerations, Heat effects, Weldability and join ability. Welding terms and definitions, welding positions, elements of and construction of welding symbols.**Weld joint preparation and temperature control**: Checks prior to weld joint preparation, joint preparation checks, preheating and interpass heating, post weld heating, heating processes, post heat treatments, insulation of heated joints.

UNITII: Consumable electrode arc welding: Shielded Metal Arc Welding, Flux cored Arc Welding, Gas Metal Arc Welding, and Stud welding.

Non-consumable electrode welding processes: Gas tungsten arc welding, gas tungsten arc spot welding and plasma arc welding.

UNIT III: Resistance and solid state welding processes:

Theory of resistance welding: Heating, pressure, current and current control, power supply.

Resistance welding processes: Resistance spot welding, resistance seam welding, Projection welding.Advantages and limitations of resistance welding.

Other welding processes: Oxy-fuel gas welding- processes,Thermit welding, Electro-slag welding, Electron beam welding, Laser beam welding, Flash welding

UNIT IV: Welding Metallurgy

Solidification of weld metal: Principle of solidification of weld metal, modes of solidification, effect of welding parameters on weld structure, grain refinement principle of weld metal, method of weld metal refinement, inoculation, arc pulsation, external excitation.

Heat affected zone and weld metal: Transformations in HAZ of steel, factors affecting changes in microstructure and mechanical properties of HAZ, reactions in weld pool- gas metal reaction, slag metal reaction.

Metallurgical issue in weld joint: Mechanisms, causes and remedy of cold cracking, solidification cracking, nonmetallic inclusions, lamellar tearing, hydrogen damage, banding, segregation

UNIT V: Weldment Inspection and Testing

Codes governing welding inspection: Structural welding code; ASME boiler and pressure vessel code, spot examination of welded joints, duties of the inspector, ASTM standards, API standards.

Magnetic particle and Radiographic inspection: Magnetic particle inspection, types of magnetizing currents, demagnetization, interpretation of patterns, non-relevant indications, radiographic sources, detectable discontinuities.

Chemical, Metallurgical, and Mechanical testing of weldments: Comparison of destructive and non-destructive tests, chemical tests, forms of corrosion, testing for corrosion resistance, metallographic tests.

Visual and liquid penetrant inspection: Selection of NDT method, relationship of welding processes, discontinuities and inspection methods, visual inspection prior to, during and after welding, liquid penetrant test.

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COURSE CONTENT: MECHANICAL ENGINEERING

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

1. **State** the theoretical aspects of welding technology in depth.
2. **Select** the appropriate welding process for a particular application.
3. **Describe** the basic metallurgy of melted and HAZ of a metal or alloy.
4. **Identify** the cause of welding defects and avoid them.
5. **Analyze** welding parameters and techniques to optimize the weldment properties.
6. **Demonstrate** their ability to check weldment quality by inspection and testing methods.

Text & References Books:

1. DeGarmo's Materials and processes in Manufacturing
2. Lancaster J F, "Metallurgy of welding", Allen and Unwin Co.
3. K Esterling, "Introduction to Physical Metallurgy",
4. "Welding Handbook", Volumes 1, 2 and 3, 9th edition, American Welding Society
5. Larry J and Jeffus L, "Welding Principles and Applications", 5th edition, Delmer Publications
6. Parmer R. S., 'Welding Engineering and Technology', Khanna Publishers, 1997
7. Hull., 'Non-Destructive Testing', ELBS Edition, 1991

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-804(iii): Optimization Techniques

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Elective-IV	Optimization Techniques	BMEL-804(iii)	3	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objective: To make the students to understand:

1. To become familiar with different optimization techniques that can learn from available examples.
2. To design and analyze experiments statistically.
3. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
4. To provide the mathematical background for carrying out the optimization and familiarizing genetic algorithm for seeking global optimum in self-learning situation

Syllabus

UNIT- I INTRODUCTION TO FACTORIAL DESIGN:
Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and surfaces, Blocking in a factorial design.

UNIT –II TAGUCHI METHOD OF DESIGN OF EXPERIMENTS:
Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Analysis of Variables (ANOVA), Analysis of Mean (ANOM), Quality characteristics (noise and control factors).
RESPONSE SURFACE METHODOLOGY: Introduction to RSM, Response Surface Design, and Analysis of data from RSM Design.

UNIT- III GENETIC ALGORITHM: Basic concepts, working principle & procedures of Genetic Algorithm (GA), flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators Cross over - Mutation – Reproduction, Generational Cycle, Fitness Computations, applications.

UNIT-IV FUZZY LOGIC: Fuzzy set theory, Fuzzy relation, Operation on Fuzzy Relation, α-Cuts of Fuzzy Relation, Composition of Fuzzy Relations, Fuzzy Logic & Controller: Concept of Fuzzy-Logic, Fuzzy Inference System with Fuzzy Application.

UNIT-V ARTIFICIAL NEURAL NETWORK (ANN):
Concept of Artificial Neural Network (ANN) supervised & unsupervised learning. Back propagation algorithm (computer program) for ANN and possible applications

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

1. **Define or discuss** the application of soft computing technique in mechanical engineering.
2. **Identify** the optimization tool for given problem.
3. **Analyze** and appreciate the importance of optimizations and its use in mechanical engineering fields and other domains Compare different optimization technique for given problem.
4. **Measure** system, design a plan to identify if the measurement system is capable.
5. **Evaluate** the efficiency of a hybrid system and how Neural Network and fuzzy logic can be hybridized to form a Neuro-fuzzy network and its various applications.
6. **Design** experiments to identify the main effects, interaction effects and their significance.

Text & Reference books:

1. Taguchi, Introduction to Quality Engineering, Asian Productivity Organization, G. UNIPUB, White Plains, New York.
2. Taguchi, System of Experimental Design: Engineering Methods to Optimize Quality and Minimize Cost, G. UNIPUB, White Plains, New York
3. Douglas C Montgomery, Design and Analysis of Experiments, John Wiley.
4. John P.W.M., Statistical Design and Analysis of Experiments, Macmillan.
5. Myres R.H., Montgomery D. C., Response Surface Methodology: Process And Product Optimization Using Designed Experiments, Wiley, New York
6. Kalyanmoy Deb, Optimization Methods, Prentice Hall of India
7. Rajasekaran and Vijayalakshmi Pai, Neural Network, Fuzzy Logic and Genetic Algorithm, PHI Learning
8. Siman Haykin, Neural Netowrks, Prentice Hall of India
9. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India.
10. Kumar Satish, Neural Networks, Tata Mc Graw Hill

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COURSE CONTENT: MECHANICAL ENGINEERING

BMEL-804(iv): Maintenance Engineering

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Elective-IV	Maintenance Engineering	BMEL-804 (iv)	3	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objective: To make the students to understand:

1. To learn the Maintenance Management, Maintenance Planning and Scheduling, Computerized Maintenance Management Systems.
2. To learn the Maintenance Organization Structure and Policies.
3. To understand the Controlling Maintenance Costs , Life Cycle Cost Concepts.
4. To learn the Optimizing Spare Parts Inventory Levels and Total Productive Maintenance Concepts.
5. To learn the overall configuration and Maintenance of Production Machines , Manufacturing System.

Syllabus

Unit-I Introduction: Requirements, Maintenance, Engg., Maintenance Management. Types of Maintenance Break down. Preventive, Predictive, Routine. Continuous Schedule. Maintenance Contract. Repair, Activity, Failure Analysis. Causes of Equipment Failure. Failure Maintenance, Dismantling Procedure. Sources of Overloading, Operating Practices to Reduce Maintenance. Issues, Problems, Selection of System. Renovation, Addition, Restoration & Control.

Unit-II Maintenance Organization: Function, Layout, Centralized & Decentralized Maintenance. Incentive, Human factors. Maintenance of Plant & Sanitation. Prerequisites, Programmes, Strategies, Policies.

Unit-III Work Measurement in Maintenance: Work Authorization & Contact. Ratting & Evaluation. Work Simplification Fstimation of Repair & Maintenance Cost. Cost Control for Efficient Operation. Small Plant Maintenance Control. Performance Indies Maintenance –A System Approach Maintenance Log Book.

Unit-IV Maintenance Store & Inventory Control: Store Room Materials & Standard Spares. Spares Management. Introduction to Computer in Maintenance. Automation Maintenance. Information by Computers. Computerized Planning & Scheduling. Maintenance fo Elevators. Lifts. Bearing. Complings. Chains. Cranes. Hoists. Belts. Gears. Batteries.

Unit-V Maintenance of Utilities: Compressed Air, Steam, Refrigeration & Air Conditioning. Compressor, Valves, lubrication Control System. **Total Productive Maintenance:** Activities, Planned Maintenance, Autonomous Effect, Evaluation Organization . Maintenance Aims. Step. Total Preventive Maintenance of Air Conditioning . Equipment, Ventilation Fans. Dust Collecting Equipments Pumps.

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

1. **Develope** Maintenance Key Performance Indicators
2. **Create** a preventive maintenance plan and monitor its implementation and review of technical reports**.**
3. **Implement** team based continuous Improvement in Maintenance
4. **Apply** knowledge about Managing Maintenance Spare Parts and Logistics
5. **Perform** maintenance orders issued by the in charge, implemented and completed in the promised time for him and to make sure the machine is clean after the maintenance process.
6. **Select** the process having highest quality of production and the continuation of the workflow.

Text & Reference books:

1. Bikash Bhadury. 'Total Productive Maintenance". Allied Publisher Ltd. New Delhi.
2. BC langlay. "Plant Maintenance". Prentice-Hall International. New Jersey.
3. JD Pattern. Jr. "Maintainability and Maintenance Management". Instrument society of America, third edition.
4. P Gopalakrishnan and AK Banerji, "Maintenance and Spare Parts Management". Prentice-Hall of India (P) Ltd. New Delhi.
5. Kelly, "Maintenance Planning & Control"

BMEL-804(v): Project Management

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Elective-IV	Project Management	BMEL-804 (v)	3	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Objective: To make the students to understand:

1. business concepts and tools to facilitate project success
2. appropriate legal and ethical standards
3. Calculations of PERT/CPM and linear programming
4. The concept of Project auditing, project appraisal and project monitoring
5. the fundamentals and recent trends in project management and performance criteria

Syllabus

Unit-I Introduction to project management

Project definition – The nature and scope of project management – Project Management process –Context of project management – Project parameters / variables: - Scope, Cost, Time, Quality, Risk –Project classifications – Project success criteria, Project management techniques Project management techniques – Project planning – Earned value management – Risk management – Scheduling – Process improvement

Unit II Planning and Scheduling

Planning and Scheduling: - Sequence of activities – Plan with chart – PERT / CPM – Work break down structure – Project management mile stones – Body of knowledge (PMI) – ISO 10006 – Scrum (agile method) – Extreme project management – Morse carlo simulations techniques – Use of software in project management – Progress monitoring – Corrective action.

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Unit-III Linear programming and network flow

Linear programming and network flow formulations; PERT/Cost accounting, scheduling with limited resources. Generalized activity networks, Gantt./bar, Mill stone chart Prospects of PERT/CPM,
Project appraisal Project Monitoring, Project Control and Project auditing, and selection, recent trends in project management.

Unit IV Project Commercial Aspects

Commercial aspects of project – Cost estimates – Time estimates – Resources estimate – Control of cost - time – resources (utilization) – Risk management – Project procurement – Selection and management of contractors – Method of payment – Authorization levels – penalty clause – stock and inventory planning Project Legal Aspects

Unit-V Legal aspects of project

Legal aspects of project – Health - Safety – Occupational hazards and environmental aspects – Ethical issues – Governmental rules and regulations – fox workers – ESI - Workmen compensation – Medical facilities – Arbitration.

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COURSE CONTENT: MECHANICAL ENGINEERING

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

1. **Identify** project goals, constraints, deliverables, performance criteria, control needs and resource requirements
2. **Implement** project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques
3. **Apply** appropriate legal and ethical standards
4. **Appraise** the role of project management in organization change.
5. **Develop** plans with relevant people to achieve the projects goals.
6. **Implement** general business concepts, practices, and tools to facilitate project success

Text & Reference books:

1. Project management, Jack R. Meredith & Samnel J. Mantel, Jr.; John Wiley & Sons
2. Harrison "Advanced Project Management" F.L.-. Metropolitan Book Co., N. Delhi.
3. Kezner, Harold- "Project Management" Van Nostrant Reinghold: Newyork
4. Levine, Harvey A. "Project Managing using Micro computers"
5. Moder J. J. Phillips CR and EW Davis "Project Management with CPM, PERT and Precedence Drawings" CBS Publishers, New Delhi.
6. Saxena KR (ed.) 1991"Project Management for Developing Countries"
7. Weigsht Jerome D and Ferdinand K. Levy, "A Management guide to PERT/CPM" Prentice Hall of India. New Delhi.