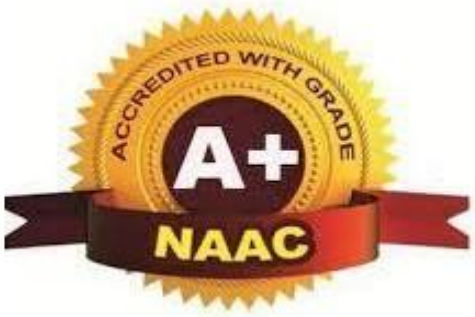
TULSIRAMJI GAIKWAD-PATIL
College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institution



DEPARTMENT OF MECHANICAL ENGINEERING

Credit Base Choice System (CBCS)

Teaching Scheme From

Academic Year 2021-22

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

Faculty of Science & Technology

Course Scheme of Bachelor of Engineering (Mechanical Engineering)

		CREDITS								
Sr. No	**Course Category**	SEM I	SEM II	SEM III	SEM IV	SEM V	SEM VI	SEM VII	SEM VIII	**TOTAL**
1	Humanities, Social Sciences & Management courses	3			3	3				**9**
2	Basic Science courses	9	9	4						**22**
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	7	13							**20**
4	Professional core courses			16	17	14	15			**62**
5	Professional Elective courses relevant to chosen specialization/branch						6	7	7	**20**
6	Open Electives: Courses from other technical and /or emerging subjects					3		6	3	**12**
7	Project work, seminar and internship in industry or elsewhere, Industry Training and Skill Development					1	2	6	6	**15**
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]									**0**
	TOTAL	**19**	**22**	**20**	**20**	**21**	**23**	**19**	**16**	**160**
	TOTAL MARKS	**600**	**600**	**650**	**650**	**650**	**700**	**500**	**550**	**4900**

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Science & Technology

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

I Semester B. E. (Mechanical Engineering)

Sr No	Course Code	Category	Course Title	Teaching Scheme (Hours/Week)			Credits	Examination Scheme									
								Theory					Practical				
				L	T	P		Duration of Exam (Hrs)	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks
1		Basic Science course	Mathematics - I	3	1	-	4	3	30	70	100	40	-	-	-	-
2		Basic Science course	Applied Physics	3	1	-	4	3	30	70	100	40	-	-	-	-
3		Engineering Science Courses	Engineering Graphics	1	-	-	1	2	15	35	50	20	-	-	-	-
4		Engineering Science Courses	Energy & Environment	3	-	-	3	3	15	35	50	20	-	-	-	-
5		Humanities, Social Sciences &	Communication & Aptitude Skills	2	-	-	2	-	15	35	50	20	-	-	-	-
6		Engineering Science Courses	Basics of Civil & Mechanical	4	-	-	Audit (0)	-	50	-	50	-	-	-	-	-
7		Basic Science course	Applied Physics Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
8		Engineering Science Courses	Engineering Graphics Lab	-	-	4	2	-	-	-	-	-	25	25	50	25
9		Engineering Science Courses	Energy & Environment Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
10		Humanities, Social Sciences &	Communication Skills Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
11		Mandatory Course	Induction Program	Three Weeks			-	-	-	-	-	-	-	-	-	-	-
Total				**16**	**2**	**10**	-	-	**155**	**245**	**400**	-	**100**	**100**	**200**	-	
Semester Total				**28**			**19**	**Marks 600**									

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Science & Technology

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

II Semester B. E. (Mechanical Engineering)

Sr No	Course Code	Category	Course Title	Teaching Scheme (Hours/Week)			Credits	Examination Scheme								
								Theory					Practical			
				L	T	P		Duration of Exam (Hrs)	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks
1		Basic Science course	Mathematics -II	3	1	-	4	3	30	70	100	40	-	-	-	-
2		Basic Science course	Applied Chemistry	3	1	-	4	3	30	70	100	40	-	-	-	-
3		Engineering Science Courses	Advance Engineering Materials	3	-	-	3	2	15	35	50	20	-	-	-	-
4		Engineering Science Courses	Engineering Mechanics	2	-	-	2	2	15	35	50	20	-	-	-	-
5		Engineering Science Courses	Basic Electrical Engineering	2	-		2	2	15	35	50	20	-	-	-	-
6		Engineering Science Courses	Computational Skills	2	-		2	2	15	35	50	20	-	-	-	-
7		Basic Science course	Applied Chemistry Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
8		Engineering Science Courses	Advance Engineering Materials Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
9		Engineering Science Courses	Workshop Practices	-	-	4	2	-	-	-	-	-	25	25	50	25
10		Engineering Science Courses	Computational Skills Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
11		Mandatory Course	Indian Culture and Constitution	2	-	-	Audit (0)	-	-	-	-	-	-	-	-	-
Total				**17**	**2**	**10**	-	-	**120**	**280**	**400**	-	**100**	**100**	**200**	-
Semester Total				**29**			**22**	**Marks 600**								

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Science & Technology

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

III Semester B. E. (Mechanical Engineering)

Sr No	Course Code	Category	Course Title	Teaching Scheme (Hours/Week)			Credits	Examination Scheme								
								Theory					Practical			
				L	T	P		Duration of Exam (Hrs)	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks
1	BEME301T	Basic Science course	Applied Mathematics – III	3	1	-	4	3	30	70	100	40	-	-	-	-
2	BEME302T	Professional core courses	Manufacturing Processes	3	-	-	3	3	30	70	100	40	-	-	-	-
3	BEME302P	Professional core courses	Manufacturing Processes Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
4	BEME303T	Professional core courses	Engineering Thermodynamics	3	1	-	4	3	30	70	100	40	-	-	-	-
5	BEME304T	Professional core courses	Kinematics of Machines	3	1	-	4	3	30	70	100	40	-	-	-	-
6	BEME305P	Professional core courses	Machine Drawing & Solid Modelling	-	1	2	2	-	-	-	-	-	50	50	100	50
7	BEME306P	Professional core courses	Computer Programming	-	1	2	2	-	-	-	-	-	50	50	100	50
8	BEME307P	Mandatory Course	Sports / Yoga / NSS/NCC	-	-	3	Audit (0)	College Assessment in Grades O, A, B, C (Evaluation guidelines mentioned in the syllabus of concerned course)								
Total				**12**	**5**	**9**	-	-	**120**	**280**	**400**	-	**125**	**125**	**250**	-
Semester Total				**26**			**20**	**Marks 650**								

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Science & Technology

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

IV Semester B. E. (Mechanical Engineering)

Sr No	Course Code	Category	Course Title	Teaching Scheme (Hours/Week)			Credits	Examination Scheme									
								Theory					Practical				
				L	T	P		Duration of Exam (Hrs)	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks
1	BEME401T	Professional core courses	Machining Processes	3	-	-	3	3	30	70	100	40	-	-	-	-
2	BEME401P	Professional core courses	Machining Processes Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
3	BEME402T	Professional core courses	Fluid Mechanics & Hydraulic Machines	3	1	-	4	3	30	70	100	40	-	-	-	-
4	BEME402P	Professional core courses	Fluid Mechanics & Hydraulic Machines Lab	-	-	2	1		-	-	-	-	25	25	50	25
5	BEME403T	Professional core courses	Material Science & Engineering	3	-	-	3	3	30	70	100	40	-	-	-	-
6	BEME404T	Professional core courses	Mechanics of Materials	3	1	-	4	3	30	70	100	40	-	-	-	-
7	BEME404P	Professional core courses	Materials Testing Lab	-	-	2	1		-	-	-	-	25	25	50	25
8	BEME405T	Humanities & Social Science	Professional Ethics	3	-	-	3	2	30	70	100	40	-	-	-	-
9	BEME406P	Mandatory Course	Sports /Yoga / NSS/NCC	-	-	3	Audit (0)	College Assessment in Grades O, A, B, C (Evaluation guidelines mentioned in the syllabus of concerned course)								
TOTAL				**15**	**2**	**9**	-	-	**150**	**350**	**500**	-	**75**	**75**	**150**	-
Semester Total				**26**			**20**	**Marks 650**								

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Science & Technology

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

V Semester B. E. (Mechanical Engineering)

Sr No	Course Code	Category	Course Title	Teaching Scheme (Hours/Week)			Credits	Examination Scheme								
								Theory					Practical			
				L	T	P		Duration of Exam (Hrs)	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks
1	BEME501T	Professional core courses	Heat Transfer	3	1	-	4	3	20	80	100	40				
2	BEME501P	Professional core courses	Heat Transfer Lab	-	-	2	1		-	-	-	-	25	25	50	25
3	BEME502T	Professional core courses	Energy Conversion-I	3	1	-	4	3	20	80	100	40	-	-	-	-
4	BEME503T	Professional core courses	Design of Machine Elements	3	1	-	4	3	20	80	100	40	-	-	-	-
5	BEME503P	Professional core courses	Design of Machine Elements Lab	-	-	2	1		-	-	-	-	25	25	50	25
6	BEME504T	Humanities, Social Sciences & Management courses	Industrial Econmics and Management	3	-	-	3	3	20	80	100	40	-	-	-	-
7	BEME505T	Open Elective Course	Open Elective - I	3	-	-	3	3	20	80	100	40	-	-	-	-
8	BEME506P	Project work, seminar and internship in industry or elsewhere	Industrial Visit*	-	-	2	1	-	-	-	-	-	50	-	50	25
9	BEME507P	Mandatory Course	Performing Art	-	-	3	Audit (0)	College Assessment in Grades O, A, B, C (Evaluation guidelines mentioned in the syllabus of concerned course)								
TOTAL				**15**	**3**	**9**	-	-	**100**	**400**	**500**	-	**100**	**50**	**150**	-
Semester Total				**27**			**21**	**Marks 650**								

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Science & Technology

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

VI Semester B. E. (Mechanical Engineering)

Sr No	Course Code	Category	Course Title	Teaching Scheme (Hours/Week)			Credits	Examination Scheme								
								Theory					Practical			
				L	T	P		Duration of Exam (Hrs)	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks
1	BEME601T	Professional core courses	Automation in Production	3	1	-	4	3	30	70	100	40	-	-	-	-
2	BEME601P	Professional core courses	Automation in Production Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
3	BEME602T	Professional core courses	Energy Conversion-II	3	1	-	4	3	30	70	100	40	-	-	-	-
4	BEME602P	Professional core courses	Energy Conversion Lab	-	-	2	1		-	-	-	-	25	25	50	25
5	BEME603T	Professional core courses	Dynamics of Machines	3	1	-	4	3	30	70	100	40	-	-	-	-
6	BEME603P	Professional core courses	Dynamics of Machines Lab	-	-	2	1		-	-	-	-	25	25	50	25
7	BEME604T	Professional Elective courses	Elective - I	3	-	-	3	3	30	70	100	40	-	-	-	-
8	BEME605T	Professional Elective courses	Elective - II	3	-	-	3	3	30	70	100	40	-	-	-	-
9	BEME606P	Project work, seminar and internship in industry or elsewhere	Skill Development*	-	-	4	2	-	-	-	-	-	50	-	50	25
10	BEME607P	Project work, seminar and internship in industry or elsewhere	Summer Internship**	During Summer Vacation			Audit (0)	-	-	-	-	-	-	-	-	-
11	BEME608P	Mandatory Course	Environment Science	-	-	2	Audit (0)	College Assessment in Grades O, A, B, C (Evaluation guidelines mentioned in the syllabus of concerned course)								
TOTAL				**15**	**3**	**13**	-	-	**150**	**350**	**500**		**125**	**75**	**200**	-
Semester Total				**31**			**23**	**Marks 700**								

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Science & Technology

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

VII Semester B. E. (Mechanical Engineering)

Sr No	Course Code	Category	Course Title	Teaching Scheme (Hours/Week)			Credits	Examination Scheme								
								Theory					Practical			
				L	T	P		Duration of Exam (Hrs)	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks
1	BEME701T	Professional Elective courses	Elective - III	3	-	-	3	3	30	70	100	40	-	-	-	-
2	BEME702T	Professional Elective courses	Elective - IV	3	-	-	3	3	30	70	100	40	-	-	-	-
3	BEME702P	Professional Elective courses	Elective - IV Lab	-	-	2	1		-	-	-	-	25	25	50	25
4	BEME703T	Open Elective Course	Open Elective - II	3	-	-	3	3	30	70	100	40	-	-	-	-
5	BEME704T	Open Elective Course	Open Elective - III	3	-	-	3	3	30	70	100	40	-	-	-	-
6	BEME705P	Project work, seminar and internship in industry or elsewhere	Project - I	-	-	12	6	-	-	-	-	-	50	-	50	25
7	BEME706P	Mandatory Course	Self Development	-	-	2	Audit (0)	College Assessment in Grades O, A, B, C (Evaluation guidelines mentioned in the syllabus of concerned course)								
TOTAL				**12**	**0**	**16**	-	-	**120**	**280**	**400**	-	**75**	**25**	**100**	-
Semester Total				**28**			**19**	**Marks 500**								

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Science & Technology

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

VIII Semester B. E. (Mechanical Engineering)

Sr No	Course Code	Category	Course Title	Teaching Scheme (Hours/Week)			Credits	Examination Scheme									
								Theory					Practical				
				L	T	P		Duration of Exam (Hrs)	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks	Max. Marks College Assesment	Max. Marks University Assessment	Total Marks	Min. Passing Marks
1	BEME801T	Professional Elective courses	Elective - V	3	-	-	3	3	30	70	100	40	-	-	-	-
2	BEME801P	Professional Elective courses	Elective - V Lab	-	-	2	1	-	-	-	-	-	25	25	50	25
3	BEME802T	Professional Elective courses	Elective - VI	3	-	-	3	3	30	70	100	40	-	-	-	-
4	BEME803T	Open Elective Course	Open Elective -IV	3	-	-	3	3	30	70	100	40	-	-	-	-
5	BEME804P	Project work, seminar and internship in industry or elsewhere	Project - II	-	-	12	6	-	-	-	-	-	100	100	200	100
6	BEME805P	Mandatory Course	Self Development	-	-	2	Audit (0)	College Assessment in Grades O, A, B, C (Evaluation guidelines mentioned in the syllabus of concerned course)								
TOTAL				**9**	**0**	**16**	-	-	**90**	**210**	**300**	-	**125**	**125**	**250**	**-**
Semester Total				**25**			**16**	**Marks 550**								

ELECTIVE I	ELECTIVE II	ELECTIVE III	ELECTIVE IV	ELECTIVE V	ELECTIVE VI	OPEN ELECTIVE I	OPEN ELECTIVE II	OPEN ELECTIVE III	OPEN ELECTIVE IV
VI SEM	**VI SEM**	**VII SEM**	**VII SEM (T+P)**	**VIII SEM (T & P)**	**VIII SEM**	**V SEM**	**VII SEM**	**VIII SEM**	**VIII SEM**
Mechanical Vibrations	Tribology	Design of Transmission System	Computer Aided Design	Finite Element Method	Design Optimization	Organizational Enterpreneurship Behaviour & Development	Industrial Safety & Environment	Design of Experiments	Industrial Robotics
Synthesis of Mechanism	Tool Design	Design of Material Handling System	Mechanical Measurement & Metrology	Computer Integrated Manufacturing	Stress Analysis	Automobile Engineering	Pollution and its Control	Fuel Cell Technology	Renewable Energy Resources
Operation Research	Advanced Manufacturing Techniques	Total Quality Management	Mechatronics	Refrigeration & Air conditioning	Industrial Engineering	Project Evaluation & Management	Finance & Cost Management	Intrumentation & Control	Waste Management
Production Planning & Control	CNC & Robotics	Composite Materials	Hydraulics & pneumatics	Additive Manufacturing	Green & Sustainable Manufacturing				
Convective Heat Transfer	Design of Heat Exchangers	Solar Energy & Utilization			Energy Conservation and Management				
Power Plant Engineering	Advanced I C Engines	Automobile Engineering			Computational Fluid Dynamics				

RTM Nagpur University
Mechanical Engineering –III Sem
Mathematics – III Syllabus (Theory)
Course Code-BEME301T

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	**Mathematics – III**	03	01	00	04	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	A primary objective is to introduce and develop advanced mathematical skills of students that are imperative for effective understanding of engineering subjects.
2	The topics covered will equip them with the techniques to understand advanced level Mathematics and its applications that would enrich logical thinking power.
3	Understand the impact of scientific and engineering solutions in a global and societal context.
4	Create the groundwork for post-graduate courses, specialized study, and research in mathematics.
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Apply Laplace Transform to solve ordinary differential equations, Integral equations and Integro-differential Equations.
CO2	Apply Fourier series in the analysis of periodic functions in terms sine and cosine encountered in engineering problems and Fourier Transform to solve integral equations.
CO3	Learn the concept of differentiating, integrating and expanding of analytic functions in complex numbers and their applications such as evaluation of integrals of complex functions
CO4	Solve partial differential equations of first order, higher order with constant coefficients and of second order using method of separation of variables.
CO5	Analyze real world scenarios to recognize when matrices are appropriate, formulate problems about the scenarios, creatively model these scenarios in order to solve the problems using multiple approaches. .

Mathematics III -SYLLABUS	
Contents	No of hours
Unit I LAPLACE TRANSFORM Definition, Properties (Statement only), Evaluation of integrals by Laplace transform, Inverse Laplace transform using partial fraction method and properties of Laplace transform, Convolution theorem (Statement only), Laplace transform of periodic functions (Statement only), Unit step function and unit impulse function (Statement only), Applications of Laplace transform to solve ordinary differential equations, Integral equations & Integro-differential equations.	10
Unit II **FOURIER SERIES & FOURIER TRANSFORM** **Fourier Series:** Periodic functions and their Fourier expansions, Even and odd functions, Change of interval, Half range expansions. **Fourier Transform:** Definition and Properties (excluding FFT), Fourier integral theorem, Applications of Fourier transform to solve integral equations.	10
Unit III **FUNCTIONS OF COMPLEX VARIABLES** Analytic function, Cauchy-Riemann conditions, Harmonic function (Excluding orthogonal system), Milne-Thomson method, Cauchy integral theorem & integral formula (Statement only), Taylor's & Laurent's series (Statement only), Zeros and singularities of analytic function, Residue theorem (Statement only).	10
Unit IV **PARTIAL DIFFERENTIAL EQUATIONS** Partial differential equations of first order first degree i.e. Lagrange's form, Linear homogeneous equations of higher order with constant coefficients, Method of separations of variables, Simple applications of Laplace transform to solve partial differential equations (One dimensional only).	10
Unit V **MATRICES** Linear dependence of vectors, Eigen values and Eigen vectors, Reduction to diagonal form, Singular value decomposition, Sylvester's theorem (Statement only), Largest eigen value and corresponding eigen vector by iteration method.	08

Text/Reference Books:

(1) Advanced Engineering Mathematics (Wiley), Erwin Kreyzig.
(2) Higher Engineering Mathematics (Khanna Publishers), B. S. Grewal.
(3) Advanced Engineering Mathematics (S. Chand), H. K. Dass.
(4) Applied Mathematics for Engineers and Physicists, L. A. Pipes and L. R. Harville.
(5) Advanced Mathematics for Engineers, Chandrika Prasad.
(6) A text book of Engineering Mathematics (Laxmi Publication), N. P. Bali & M. Goyal.

RTM Nagpur University
Mechanical Engineering –III Sem
Manufacturing Processes Syllabus (Theory)
Course Code- BEME302T

Semester	Course Title	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Exam	Total	
III	Manufacturing Processes	3	00	00	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To understand the pattern making, gating system, moulding process and casting process.
2	To expose the students to the principles of the metal joining methods.
3	To study metal forming techniques, rolling, drawing, sheet metal forming, shearing operations and knowledge about process behavior.
4	To learn about plastics, ceramics and glass along with properties, types, applications and shaping
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the importance of manufacturing processes, techniques of pattern making and moulding with their properties. Design gating system along with selection of different types of melting furnaces and special casting process.
CO2	Get acquainted with the basic concept of joining process, welding process and its types, defects and application.
CO3	Get acquainted with the forming process for metal, mechanics of forming process along with different types of rolling machine.
CO4	Understand and define press working process along with its classification, types and terminology, different types of dies and introduction to shaping operation.
CO5	Understand introduction to plastics, ceramics and glasses, its properties, application, forming and its shaping.

Manufacturing Processes Syllabus	
Contents	**No of hours**
Unit I **Pattern Making & Moulding:** - Pattern making: Types, materials used, Pattern making allowances, color codes. **Moulding sand:** Composition, moulding sand properties, Sand testing - Grain fineness, moisture content, clay content and permeability test. Core making: - Types, core material & its properties. Types of sand moulds. **Gating System & Casting Processes:** - Gating design - Elements of gating systems, riser design. Melting furnaces - Types, Electric furnace, Induction furnace, Cupola construction & operation, Cleaning, inspection & casting defects - types, causes & remedy. Moulding machines. Special casting processes such as Investment Casting, Centrifugal Casting, Slush Casting, Die Casting, Shell moulding and CO_2 moulding.	10
Unit II **Joining Processes:** - Major grouping of joining processes, welding, brazing and Soldering, Broad classification of welding processes, types and Principles. Electrodes, weldability of Metals, Welding equipments. Fixtures, Arc Welding & Gas Welding Processes, TIG Welding, MIG Welding, Spot Welding, Plasma Arc welding and Electron Laser Beam welding. **Weld:** Inspection, Defects in various joints and their remedies. **Joint through Adhesive –** classification of adhesive, types of adhesive, applications. ,	09
Unit III **Forming Process for metals:**- Rolling, Forging, Extrusion, Drawing, Mechanics of forming process, Determination of Rolling pressure and roll specification force, drive force and torque, power loss in bearing, Determination of forging forces and stresses, Equipment (hammer/press) capacity required. (No analytical treatment) ,	09
Unit IV **Sheet metal working**: - Classification, types of presses, press terminology, Force analysis in press working, Die cutting operation, types of dies, Die and punch allowance, introduction to shaping operations, bending, forming and drawing. ,	08
Unit V Introduction to Plastics, Properties & types, applications, Forming & Shaping of plastics – Extrusion, injection moulding, Blow moulding, wire drawing, Compression moulding, Transfer moulding, Embossing, Calendaring. Ceramic Structure, Properties, and Applications, Shaping Ceramics, Glasses Structure, Properties, and Applications, Forming and shaping of glass, Composite materials, Processing of metal matrix and ceramic matrix composites, Processing semiconductors. ,	09

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students as assignments.

References:

Text Books Recommended:

1. Workshop Practice, H. S. Bawa, Tata Mc-Graw Hill
2. Manufacturing Engineering & Technology, Kalpakjian, Pearson
3. Modern Materials and Manufacturing Process, R. Gregg Bruce, John E. Neely,Pearson Education
4. Degarmon's Materials and Processes in Manufacturing, 11th Ed. Black, Ronald A Kohser, Wiley India
5. Workshop Technology (Volume I), Hajra Chaudhary, Media Promoters &Publishers
6. Workshop Technology (Vol. I & II), B. S. Raghuwanshi, Dhanpat Rai & Co.
7. Manufacturing technology (Vol. I), P. N. Rao, Tata Mc-Graw Hill
8. Manufacturing Science, Ghosh & Malik, East West Press.
9. Textbook of Production Engineering, P.C. Sharma, S. Chand & Co.
10. "ASM Metals Hand Book on Casting", 1992.
11.Parmer R.S; "Welding Processes& Technology", Khanna Publishers, 1994.
12.Lancaster J.F., George Allen and Unwin, 1991, "Metallurgy of Welding".
13.Metals Hand Book, Vol 6,8th edition, ASM, 1971.
14.AWS Welding Hand Book,Vol 1 to 4 AWS.

Reference Books Recommended:

1. Workshop Technology, Vol I & II, WAJ Chapman, Elsevier Butterworth-Heinemann.
2. Manufacturing Processes, M. Begman.
3. Processes & Materials of Manufacturing, R. Lindberg, Allyn & Bacon.

RTM Nagpur University
Mechanical Engineering –III Sem
Manufacturing Processes Syllabus (Practical)
Course Code- BEME302P

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	Manufacturing Processes	00	00	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Think in core concept of their engineering application by studying various topics involved in branch specific applications.
CO2	Understand the relevance and importance of the Different manufacturing techniques and real life application in industry.
CO3	Design the gating and riser system needed for casting and requirements to achieve defect free casting.
CO4	Analyze the welding process behavior and requirements to achieve sound welded joint while welding different similar and dissimilar engineering material
CO5	Understand the plastic, glass and ceramic Processing

Sr. No.	List of Practical's
01	Study of Cupola Furnace.
02	Study of Moulding Techniques
03	Study of Casting Process
04	Study of Pattern Making
05	Study of Joining Processes
06	Study of Forming Processes
07	Study of Drawing Processes
08	One Job – Pattern Making
09	One Job – Casting
10	One Job – on TIG/ MIG/ Resistance welding
11	Demonstration on Plastic, Glass and Ceramic Processing (Industrial Visit)

Suggested References:

1. Workshop Technology, Vol I & II, WAJ Chapman, Elsevier Butterworth-Heinemann.
2. Manufacturing Processes, M. Begman.
3. Processes & Materials of Manufacturing, R. Lindberg, Allyn & Bacon

RTM Nagpur University
Mechanical Engineering–III Sem
Engineering Thermodynamics Syllabus (Theory)
Course Code- BEME303T

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.E. III Sem	**Engineering Thermodynamics**	3	1	-	4	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	This course deals with the fundamentals of Thermodynamics, including thermodynamic systems and properties, relationships among the thermos-physical properties, the laws of thermodynamics and applications of these fundamental laws in thermodynamic systems
2	To present a comprehensive and rigorous treatment of classical thermodynamics while retaining an engineering perspective.
3	Explain the working principle of various power cycles used in thermal systems.
Course Outcomes	
After successful completion of this course, the student will be able to:	
CO1	**Explain** thermodynamics concepts, **relate** laws of the ideal gas, **identify** various thermodynamic processes and apply the laws to **determine** the energy transfer in terms of heat and work.
CO2	**Explain** the first law of thermodynamics and **apply** the law to **evaluate** open, closed systems, thermal components and devices.
CO3	**Interpret the** second law of thermodynamics, entropy, and apply the law to evaluate heat engine, heat pump, and refrigerator performance.
CO4	**Relate** various steam properties, and **analyze** the different types of processes using steam as working fluid to **determine** the energy transfer in terms of heat and work.
CO5	**Compare** various power cycles and **analyze** the cycles to **determine** the energy transfer in terms of heat, work and efficiency.

Engineering Thermodynamics Syllabus	
Contents	No of hours
Unit I Basic concepts of Thermodynamics, Systems and their types, Property, State, Process, Phase, Cycles. Comparison of microscopic and macroscopic approaches. Path and point functions. Thermodynamic Equilibrium. Zeroth law of thermodynamics and its significance for temperature measurement Introduction to First law of thermodynamics, Energy transfer, Heat and work transfer. Ideal Gas laws: Boyle's law, Charle's law, Gay-Lussac's law, Avagadro's law, Equation of state, General gas equation, Specific Heat, Universal gas constant. Thermodynamic Processes: Constant pressure, Constant volume, Isothermal, Isentropic and Polytropic process, representation on P-V and T-s Diagram, Calculation of Heat transfer, Work done, Change in Internal Energy and Enthalpy for these processes.	10
Unit II The first law of Thermodynamics for Closed System undergoing a process and cycle (Control Mass System) and Open System (Control Volume System) Steady Flow process applies to Compressor, Pump, Turbine, Boiler, Steam Nozzle, Throttling Device, Heat Exchanger, Fan and blower. (Analytical treatment on First law applied to thermodynamic processes and cycles and Steady low energy equation applied to various flow devices is expected). ,	9
Unit III Second Law of Thermodynamics:- Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat Pump, Kelvin-Plank and Clausius Statements, Perpetual Motion Machine I and II, Carnot Cycle, Thermodynamic Temperature scale. Entropy:- Clausius Inequality, Entropy, Principle of Increase of Entropy, Change in Entropy for different thermodynamics processes with T-S Diagram, Reversible and Irreversible Processes. (Simple analytical treatment on COP calculation is expected) ,	9
Unit IV Properties of Steam:- Formation of steam and its thermodynamic properties like Sensible Heat, Latent Heat, Critical State, Triple Point, Wet Steam, Dry Steam, Superheated Steam, Dryness Fraction, Enthalpy, Internal Energy of Steam, External Work Done during Evaporation, T-S Diagram, Mollier Chart, Work and Heat Transfer during various Thermodynamic Processes with steam as working fluid. Measurement of Dryness Fraction using various Calorimeters. (Analytical Treatment using steam table and Mollier chart is expected) ,	9

Unit V Power Cycles: - Otto Cycle, Diesel Cycle, Dual Cycle, Brayton Cycle, Representation on P-v and T-s diagrams. The equation for work done, heat transfer, air standard efficiency, and mean effective pressure. Comparison of Otto, Diesel and Dual cycles. Introduction to simple vapour power cycle, i.e., Rankine cycle (Analytical treatment in terms of calculation Work done & efficiency analysis is expected on Otto Cycle, Diesel Cycle and Dual Cycle)	9
Total Hours	46

Sr. No.	List of Tutorials
01	Application of first law to control mass (closed system) system
02	Application of first law to control volume (open system) system
03	Determination of Heat transfer, Work done, Change in Internal Energy and Enthalpy of various thermodynamic processes and cycles.
04	Determination of various properties of steam by using Steam table and Mollier chart
05	Application of second law to heat engine, refrigerator and heat pump.
06	Thermodynamic analysis of Otto cycle.
07	Thermodynamic analysis of Diesel cycle.
08	Thermodynamic analysis of Dual cycle and Brayton cycle.

References:

Text Books Recommended:

1. Engineering Thermodynamics, P. K. Nag, Tata McGraw-Hill Publications
2. Thermodynamics, S. C. Gupta, Pearson Publications
3. Thermal Engineering, P. L. Ballani, Khanna Publications
4. Engineering Thermodynamics, S.S. Khandare, Charotar Publication House
5. Engineering Thermodynamics, R. K. Rajput, Laxmi Publication

Reference Books Recommended:

1. Thermodynamics and Engineering approach, Yunus A. Cengel, Michael A. Boles, Tata McGraw-Hill Publications
2. Engineering Thermodynamics, D. P. Mishra, Cengage Learning Publications
3. Engineering Thermodynamics, Gordon Rogers, Pearson Publications

RTM Nagpur University
Mechanical Engineering –III Sem
KINEMATICS OF MACHINES (Theory)
Course Code- BEME304T

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	KINEMATICS OF MACHINES	3	1	0	4	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	Make student conversant with the process of motion transformation, develop ability to critically analyse the machines, mechanisms and controlling devices, and contrive new mechanisms.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Perform kinematic and dynamic analysis (Displacement, Velocity, acceleration, Inertia forces) of a given mechanism using analytical and graphical method.
CO2	Understand the concept of compliant mechanisms.
CO3	Contrive or synthesize new mechanisms for specific requirements and Perform computer aided analysis of simple mechanisms.
CO4	Construct cam profiles and analyse the follower motion.
CO5	Understand Geometry of gear, its types, analysis of forces and motions of gear teeth. Study of gear trains and governors.

KINEMATICS OF MACHINES SYLLABUS	
Contents	No of hours
Unit I - INTRODUCTION Basic concept of mechanism, link, kinematics pairs, kinematics chain, mechanism, Difference between machine and mechanism, Inversions, machine, simple & compound chain, Degrees of freedom, Estimation of degree of freedom of mechanism by Grubber's criterion and other methods. Harding's notations, Classification of four bar chain , Class-I &Class-II, Kutzbach's criteria, Various types of mechanism such as Geneva wheel, Pawl and ratchet mechanism, Exact straight line mechanism, Approx. straight line mechanism, Pantograph mechanism. Introduction to compliant mechanisms	8
Unit II- KINEMATIC ANALYSIS a. Kinematic analysis of simple mechanisms using vector algebra (Graphical method). Concept of Corioli's component of acceleration. Velocity analysis using Instantaneous center of Rotation method, Kennedy's theorem. b. Kinematic analysis using analytical method and formulation of algorithm for computer program of kinematic analysis of four bar mechanism and slider crank mechanism (Can use excel spread sheets).	10
Unit III – KINEMATIC SYNTHESIS a. Synthesis of mechanisms, Graphical b. Synthesis of mechanisms analytical technique. Restricted to design of crank rocker and slider crank mechanism only.	6
Unit IV - Cams and followers: a. Types of cams and followers, types of follower motion, velocity and acceleration diagrams, Construction of cam profile. b. Introduction to cams with specified contours (No analytical treatment).	10
Unit V – Gears, gear trains and Governor a. Classification of gears, Types of gears, Spur gears - terminology, conjugate gear tooth action and law of gearing, involute and cycloidal profile , contact ratio, Interference and under cutting, methods of avoiding interference, minimum number of teeth,. b. Helical gears: Nomenclatures, center distance, force analysis. Spiral Gears, Worm and worm Gears, Bevel Gears; their terminologies, center distance, force analysis and efficiency, Gear Trains. c. Introduction, Types, Governor Effort and governor power, Controlling force analysis, sensitivity, stability, isochronisms and hunting, friction, insensitiveness. Introduction to modern electronic governors (Without Numerical) .	14

Sr. No.	KINEMATICS OF MACHINES : List of Tutorials
01	Demonstration of various links, joints, pairs and mechanisms available in TOM lab
02	Drawing sheets on Inversion of i) Class I & Class II four bar chain ii) Single slider crank chain iii) Double slider crank chain
03	Problem solving on kinematic analysis at least 3 No's one each on four bar mechanism and slider crank mechanism and one considering Coriolis component.
04	Cam construction activity for three hours (mini workshop)
05	Problems on gears 1. Determination of contact ration, 2. Min. number of teeth, 3. Equivalence of helical and spur gear, 4. Force analysis of spur gear one problem, 5. Force analysis of helical gear one problem.
06	One problem each on worm, bevel and spiral gears
07	Problems on gear trains at least two
08	Demonstration of various governors in TOM lab

Workshop (Guidelines): There are few concepts in the subject like motion transformation, positioning of joints and the paths generated by input output motions of links will be cleared very easily through hands on training. If a graphical technique is used to draw the locus of a point on the connecting rod same can be validated by using computer software (Soft intigration.com or by NPTL tutorial) and by building a prototype model. Here we can introduce them with design of four bar mechanism and slider crank mechanism by the simple graphical technique given in Hall A. S. Jr. or Shigley's book.

This will be a two days workshop conducted by interchanging the faculties of different institutions so that there will be interaction among design fraternity.

This activity can be planned after completion of first three units.

Assignments (Guidelines):

1. Ask students to collect list of at least 100 machines used in and around. Ask them to select any two machines and identify the basic mechanism, to draw its kinematic sketch, identify links, pairs, input and output links, input and output motion, degree of freedom.

Eg. A pedal pump of street puncher vendor, washing machine, compressor, bike, car, lathe machine, sewing machine, computer printer, printing machine, food processor, bicycle, e-vehicle, autorikshaw, various construction equipments, farm equipments, industrial machines, etc.

2. The mini project on mechanism building to be completed in the three day workshop.

3. Disassembly and assembly of gearbox/ steering/ cam follower etc and sketching the appropriate drawing of the system and a small write up about the system

References:

Text Books Recommended:

1. Theory of Machine, S. S. Rattan, Tata McGraw Hill.
2. Mechanism and Machine Theory, J.S. Rao & Dukki Patti, New Age International (P) Ltd, Publishers
3. Theory of Machines, P L Ballaney, Khanna Publications.

Reference Books Recommended:

1. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, Oxford University Press
2. Theory of Machines, Sadhu Singh, Pearson publications.
3. Advanced Mechanism Design–Analysis and Synthesis, A.G.Erdman and G.N.Sandor, Vol. I and II, Prentice – Hall
4. "Mechanisms and Mechanical Devices Source Book", Neil Sclater, Nicholas P Chrironis, McGraw-Hill
5. Kinematics and Linkage Design, A. S. Hall, Jr., Prentice – Hall
6. Mechanism Synthesis and Analysis, A. H. Soni, McGraw Hill

RTM Nagpur University

Mechanical Engineering–III Sem

Machine Drawing and Solid Modeling (tutorial)

Course Code- BEME305P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	**Machine Drawing and Solid Modeling**	-	01	02	02	-	-	-	

Sr. No.	Course Objective **The objective of this course is–**
1	To make students conversant with machine drawing standards, techniques, symbols, notations, creation of2-D and 3-D detailing of parts, GD&T, drawing reading, production drawing and process sheet.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Interpret and describe basic elements of standard machine drawing like lines, dimensions, tolerances,symbols etc.
CO2	Create 2-D detailing, sectional views of machine elements from given isometric view.
CO3	Understand and apply concepts of GD&T for creating part and assembly drawing.

Machine Drawing and Solid Modeling Syllabus	
Contents	No of hours
Unit I : Basic Drawing Standards: Drawing Sheets, Name Blocks, Types of Lines, Types of Dimensioning, Applying Tolerances, Standard Components and their representations, Standard Features, Machining Symbols, Welding Symbols, Surface Finish Symbols, Heat Treatment,Manufacturing Instructions, Allowances, Materials.	5 hrs
Unit II: Orthographic projections: 2-D orthographic projection of machine elements,Sectionalviews, Dimensioning and detailing.	5hrs
Unit III: GD & T: Concepts of Limit, Fits and Tolerances (Standard, types, application and selection for assembly and manufacturing method), Surface Finish requirement for assembly, Manufacturing Method, Geometry suitable for assembly. Principals and practical applications of geometrical dimensioning and tolerance.	5 hrs

Sr. No.	List of Tutorials
01	Drawing Sheets, Name Blocks, Types of Lines, Standard dimensioning methods, Applying Tolerances.
02	Standard Components and their representations, Standard Features.
03	Machining Symbols, Welding Symbols, Surface Finish Symbols.
04	Heat Treatment, Manufacturing Instructions, Allowances, Materials.
05	2-D orthographic projection of machine elements
06	2-D orthographic projection of machine elements
07	Sectional views
08	Dimensioning and detailing.
09	Limit, Fits and Tolerances (Standard, types, application and selection for assembly and manufacturingmethod)
10	Geometrical dimensioning and tolerances (symbols, applications) datum's, referencing.
11	**Industrial Drawing Reading:** Students to be give industrial (production) drawing of different components,they will be asked to study the drawing thoroughly, understand and interpret the meanings of symbol and notations and there importance.

References:

Text Books Recommended:

1. Naryana K.L., Kannaiah R., Venkata Reddy K “Machine Drawing”, New Age Int.Pub,
2. Naryana K.L., Kannaiah R., Venkata Reddy K “Production Drawing ", New Age Int.Pub,
3. N.D.Bhatt “Machine Drawing; Ed”, Charotar Publishing House, 33 . rd

Reference Books Recommended:

1. PSG College of Technology “Design data”, DPV Printers, Coimbature, 1 2000.
2. “Engg. Drawing practice for schools & colleges”, Bureau of Indian Standards, 1 Ed.; , 2002. st1998

RTM Nagpur University
Mechanical Engineering –III Sem
Machine Drawing and Solid Modeling Syllabus (Practical)
Course Code- BEME305P

Semester	Course Title(Subject)	Hrs/Wk			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	Machine Drawingand Solid Modeling		1	2	2	50	50	100

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Create 2-D orthographic manual drawings as well as digital drawing using CAD software packageof standard machine components
CO2	Apply standard practices for creation of 2-D orthographic manual drawings as well as digitaldrawing using CAD software package of assembly with dimension detailing, part list and ballooning. Also perform 2-D detailing of assembly components.
CO3	Create 3-D solid model and 2-D detailing of simple parts using CAD software package andperform 2-D detaining.
CO4	Create production drawing and process sheet for standard machine components.
CO5	Get hands on experience of reverse engineering process and concepts.

Sr. No.	Machine Drawing and solid Modeling (Practical)
01	2-D Orthographic pencil drawings of standard components with dimensions and detailing: Minimum Onesheet
02	2-D Orthographic pencil drawings showing sectional views of part with dimensions and detailing: MinimumOne sheet
03	2-D Orthographic pencil drawings of Assembly showing at least two views with assembly dimensioning, partlist and ballooning: Minimum One sheet
04	2-D Orthographic pencil drawings of Assembly detailing (disassembly) showing dimensional details ofassembly components : Minimum One sheet
05	Creating 3-D solid model of simple part with basic features like extrude, revolve, holes, round, chamfer fromgiven 2-D detailing using any CAD software package. Perform 2-D drafting and detailing of solid model: Print out showing 2-D detailing and pictorial view (isometric view) of part to be submitted.
06	Creating 2-D Orthographic drawings of Assembly with one sectional view with assembly dimensioning, partlist and ballooning using any CAD software package: Print out to be submitted.
07	**Production drawing and process sheet:** Prepare production drawing and process sheet of any standardmachine component using CAD software package: Submit print out.
08	**Compulsory Reverse engineering group activity (maximum 4 members in a group):** Each group to be given unique assembly comprising of minimum four components (preferably standard assembly e.g. bearing housing, tool post, clutch housing, automobile parts, parts in workshop facilities etc.). Students to disassembleall parts, study each part, identify standard components, perform complete reverse engineering process: createrough sketch of each part, measure its various dimensions using basic measuring instruments (ruler scale,

RTM Nagpur University
Mechanical Engineering –III Sem
Computer Application/Programming Syllabus (Practical)
Course Code- BEME306P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assess	University Exam	Total	
III	Computer Application/Programming	0	1	2	2	50	50	100	-

Sr. No.	Course Objective The objective of this course is–
1	To to apply knowledge of basic concepts of programming in C to solve mechanical Engineering problems
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand and explore concepts in basic programming like data types, input/output functions, operators, programming constructs and user defined functions.
CO2	Develop capabilities of writing 'C' programs in optimized, robust and reusable code
CO3	Apply appropriate concepts of data structures like arrays, structures implement programs for various applications

Computer Application/Programming SYLLABUS	
Contents	No of hours
Introduction to C programming: Basic structure of C program, Features of C language, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types	05
Operators and Expressions: Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and decrement operators, Conditional operators, Bit-wise operators, Arithmetic expressions. Evaluation of expressions, Precedence of arithmetic operators, Type conversion in expressions, Operator precedence and associativity.	05
Decision Making: Decision making with 'if' statement, Simple 'if' statement, the 'if…else' statement, nesting of 'if…else' statements, The 'else if' ladder, The 'switch' statement. The while statement, The do while statement, The 'for' statement, Jumps in loops.	05
Arrays: One dimensional arrays, Declaration of one dimensional arrays. Initialization of one dimensional arrays, Two dimensional arrays, Initializing two dimensional arrays. Declaring and Initializing String Variables, Reading Strings from Terminal, Writing strings to screen, String handling functions	05
User-defined functions: Need for User Defined Functions, Definition of functions, Return values and their types, Function calls, Function declaration. **Introduction to Pointers:** Introduction, Declaration and initialization of pointers. Examples Structures and Unions: Introduction, Structure and union definition, Declaring structure and union variables, Accessing structure members.	05

Sr. No.	Computer Application/Programming (List of Practical)
01	Development of programs in C To find area/surface area, volume for Planes, Solids. (Applications for cost involved for painting surface of any plane(square, rectangular, hexagonal etc), costing based on metal sheet material required for manufacturing cylinder(ends open/closed/one end open), cone, cube etc. with varying quantity of products)
02	Development of programs in C To find Stress with given force and cross sectional

	area(square, rectangle, circular etc)
03	Development of programs in C To find angular velocities and acceleration of the output and coupler link for four bar chain mechanism.
04	Development of programs in C for given inner, outer radii for single plate clutch and axial force calculate minimum, maximum, and average pressure acting on clutch plate.(or calculating inner outer radii, width of friction lining, axial force etc. for single/multi plate clutch or similar type of simple calculation programme for block brake.
05	Development of programs in C for Addition, Multiplication Matrices.
06	Development of programs in C for any Numerical methods like Newton Raphson, Gauss-Elimination, Gauss-Jordan, Crout's method and Gauss-Seidel Method. Development of programs in C / C+ + for any Numerical methods like Taylor's series method, Runge Kutta method, Euler's modified method, Milne's predictor corrector method, Iterative methods for eigen value & eigen vector determination.
07	Development of programs in C To determine type of flow of fluid(laminar/turbulent/transient) on the basis of Reynolds's Number
08	Development of programs in C To calculate specific density, specific weight, weight if specific gravity is given for liquid

Note: During University practical examination of 50 marks, students are expected to prepare & execute computer programs in C of total 30 marks in one hours duration. Viva-Voce of 20 marks shall be conducted during University practical examination.

References:

Text Books Recommended:

1)Programming in C , P. Dey, M. Ghosh, First Edition, 2007, Oxford University press, ISBN (13): 9780195687910.
2. The C Programming Language, Kernighan B.W and Dennis M. Ritchie, Second Edition, 2005, Prentice Hall, ISBN (13): 9780131101630.
3. Turbo C: The Complete Reference, H. Schildt, 4th Edition, 2000,Mcgraw Hill Education, ISBN-13: 9780070411838.
4. Understanding Pointers in C, Yashavant P. Kanetkar, 4th Edition, 2003, BPB publications, ISBN-13: 978-8176563581
5. C IN DEPTH, S.K Srivastava, Deepali Srivastava, 3rd Edition, 2013, BPB publication, ISBN9788183330480

Reference Books Recommended:

1. An Introduction to Data Structures with Applications, Trembly J. P. And Sorenson P. G., Tata McGraw Hill Pub. Co. Ltd.
2. Fundamentals of Computer Algorithms, Horowitz E. And Sahani S., Galgotia Publications Ltd.
3. Programming in C, Gotterfield B., Schaums Outline Series. 4. Mastering C, R. Venu Gopal Prasad, Tata McGraw Hill Pub. Co. Ltd.

RTM Nagpur University
Mechanical Engineering –III Sem
SPORTS
Course Code- BEME307P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III & IV	SPORTS	0	0	3		00	00	00	00

Sr. No.	COURSE OBJECTIVE
1	Through sports, students should able to build a wide range of abilities and skills such as leadership, confidence, teamwork, patience, self-reliance, trust, and many more which facilitate the overall development of an individual
2	Students should learn to manage time between their lectures, sports, and personal life.

EXPECTATION FROM INSTITUTES

1. Provide sports facilities
2. Provide platforms for participation in events
3. Develop interest for sports amongst students
4. Conduct regular events (every month) in college for all indoor and outdoor sports

RTM Nagpur University
Mechanical Engineering –III Sem
YOGA
Course Code- BEME307P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III &IV	YOGA	0	0	3		00	00	00	00

Sr. No.	COURSE OBJECTIVE
1	To introduce basic wellness principles and practices of Yoga to students
2	To bring awareness of the fundamentals of Yoga for wellness in their daily lives
3	To bring peace and harmony in the society at large by introducing the Yogic way of life.

EXPECTATION FROM TRAINERS

1. Brief to origin of Yoga,
2. History and Development of Yoga: Vedic Period, Classical Period, Post classical period, Modern Period.
3. Etymology and Definitions of Yoga in classical Yoga texts
4. Meaning, Aim and Objectives of Yoga,
5. Misconceptions about Yoga;
6. True Nature of Yoga;
7. Principles of Yoga;
8. Basis of Yoga.

RTM Nagpur University
Mechanical Engineering –III Sem
National Service Scheme (NSS)
Course Code- BEME307P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III & IV	National Service Scheme (NSS)	0	0	3	00	00	00	00	00

Sr. No.	COURSE OBJECTIVE
1	1. Understand the community in which they work. 2. Understand themselves in relation to their community. 3. Identify the needs and problems of the community and involve them in problem-solving. 4. Develop among them a sense of social and civic responsibility. 5. Utilize their knowledge in finding practice solutions to individual and community problems. 6. Develop competence required for group-living and sharing of responsibilities. 7. Gain skills in mobilizing community participation. 8. Acquire leadership qualities and democratic attitudes 9. Develop capacity to meet emergencies and natural disasters. 10. Practice national integration and social harmony

EXPECTATION FROM TRAINERS
5. To assist and guide the NSS unit for implementation of NSS programs at college level 6. To advise in organizing camps, training and orientation programs for the NSS volunteers 7. To visit the NSS units for monitoring and evaluation. 8. To ensure implementation of NSS regular activities and special camping programs

RTM Nagpur University
Mechanical Engineering –III Sem
National Cadet Corps (NCC)
Course Code- BEME307P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III &IV	National Cadet Corps (NCC)	0	0	3		00	00	00	00

ABOUT NCC

1. NCC is the Indian military cadet corps wing of the Indian armed forces.
2. NCC offers training to the students of schools and colleges.
3. This is not compulsory training for all students.

Sr. No.	OUTCOMES EXPECTED
1	During the training of NCC, candidates should get the basic military training. This training should be conducted to develop the interest of young students in all three forces; the army, the navy and the air force of India. Students should be able to check their abilities to join the Indian Defence Services.

Sr. No.	AIM
1	To create an organized, trained and motivated youth, create soldiers for the nation, develop the leadership skills in the youth.

EXPECTATION FROM INSTITUTES

- Create awareness amongst students about NCC
- Make understand the students about the importance of NCC
- Conduct regular Drills and Training exercises
- Conduct Regular exams
- Arrange for Training Camps

RTM Nagpur University
Mechanical Engineering
Machining Processes Syllabus (Theory)
Course code- BEME401T

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	**Machining Processes**	03	00	00	03	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	Understand basic mechanism of metal removal processes.
2	Working mechanisms of various machine tools and machining principles.
3	To know surface finishing and allied processes.
4	Understand the importance of machining processes and be able to apply the suitable machining processes for an engineering product.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand fundamentals of metal cutting
CO2	Understand basic construction and operations of lathe shaping, planning
CO3	Understand basics of milling and milling cutters. slotting
CO4	To know about the surface finishing processes.
CO5	Understand the basic of drilling, boring, reaming and broaching.

Machining Processes (Theory) SYLLABUS	
Contents	No of hours
Unit I **Introduction to Machining Parameters**: Introduction to machining, Tool materials, nomenclature and tool geometry of single point cutting tool, tool materials properties, classification, HSS, carbide tool, coated tools, diamond coated tool. Theory of Metal Cutting: Introduction. Orthogonal and Oblique cutting. Mechanics of Metal Cutting. Merchant's circle, Chip formation, cutting force calculations, cutting fluids, cutting speed, feed and depth of cut on power requirement, Estimation of tool life.	09
Unit II Lathe: Introduction, types, construction of simple lathe, mechanism and attachments for various operations, machine specifications, basis for selection of cutting speed, feed and depth of cut, time estimation for turning operations such as facing, step turning, taper turning, threading, knurling. Introduction to Capstan, Turret Lathe and fundamentals of NC. **Shaper:** Introduction, types, specification, description of machines, cutting parameters. Mechanism of shaper: Quick return mechanism, Crank & slotted link mechanism, Table feed mechanism, attachments for shaper, work holding devices, shaper operations. **Planer:** Introduction, specifications, description, types of planner, open side planner, pit planner Mechanism for planner: Driving mechanism, feeding mechanism, planner cutting tools, cutting parameters.	10
Unit III **Milling:** Introduction. Specification, types, column & knee type milling machine, fixed bed type milling machines, production milling machines, special purpose milling machines such as thread milling Machines, profile milling machine, Gear Milling. Hobbing machines. Mechanisms & Attachments for Milling, Cutting parameters, Types of milling operations, Types of milling cutters, Tool geometry & their specifications. Indexing - simple, compound and differential. **Slotter:** Introduction, specifications, description, type of drives for slotter, types of slotting machines -production slotter, puncher slotter, tool room slotter, slotter tools.	09
Unit IV **Grinding**: Operations, grinding wheel, specifications & selection, cylindrical & centreless grinding operation, surface grinding, tool & cutter grinding, time estimation for grinding operations. **Super finishing process:** Honing, Lapping, super finishing, polishing, buffing, 'metal spraying, galvanizing and electroplating. Process parameters and attainable grades of surface finish, surface measurement.	09

Unit V **Drilling:** introduction, tools for drilling, classification of drills, twist drills, drill size and specifications, tipped drills, type of drilling machines-portable drilling machine. bench drilling machine, right drilling machine, radial drilling machine, universal drilling machine, multisided drilling machine. Drilling machines operations, time estimation for drilling. **Reaming:** Introduction, description of reamer, type of reaming operations. **Boring:** Introduction, types of boring machine, horizontal boring machine, vertical boring machine, jig machine, micro boring. boring operations. **Broaching:** Introduction, type of broaches, nomenclature of broaches. types of broaching machines.	09

Sr. No.	List of Tutorials
01	Based on above syllabus

References:

Text Books Recommended:

1. Workshop technology (Vol. II), V. S. Raghuwanshi, Dhanpat Rai & Sons
2. Manufacturing Science, Ghosh & Mallik, East West Press
3. Manufacturing technology (Metal cutting & Machine tools) Vol. II, P. N. Rao, Tata Mc-Graw Hill
4. Workshop technology, H. S. Bawa, Tata Mc-Graw Hill
5. Introduction to Manufacturing Processes, J. A. Schey, Tata Mc-Graw Hill
6. Workshop Technology (Volume II), Hajra Chaudhary, Media Promoters & Publishers

Reference Books Recommended:

1. Manufacturing Engineering & Technology, S. Kalpakjian & S.R. Schmid
2. Technology of Machine Tools, Krar & Oswald
3. Manufacturing Processes, M. Begman
4. Processes & Materials of Manufacture, R. Lindberg
5. Production Technology, HMT

RTM Nagpur University
Mechanical Engineering
Machining Processes Syllabus (Practical)
Course code- BEME401P

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	Machining Processes	00	00	02	01	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand basic cutting tools.
CO2	Working of lathe and turning operation
CO3	Shaping and planning operation
CO4	Milling and drilling operation
CO5	Grinding and surface finishing

List of Practical's

Minimum Eight out of following shall be performed:

Sr. No.	List of Practical's
01	Study of Single Point Cutting Tool.
02	Study of Various forces on single point cutting tools.
03	Study of multiple point cutting tools (milling, drilling)
04	Study of Lathe Machine.
05	Study of Shaper mechanisms.
06	Study of milling machine
07	One Job on Milling.
08	One Job on Drilling, Boring
09	One Job on Thread Cutting, Taper Turning.
10	One Job on Surface Grinding.

Suggested References:

1. Manufacturing Engineering & Technology, S. Kalpakjian & S.R. Schmid
2. Technology of Machine Tools, Krar & Oswald
3. Manufacturing Processes, M. Begman
4. Processes & Materials of Manufacture, R. Lindberg Production Technology, HMT

RTM Nagpur University
Mechanical Engineering-IV Sem
Fluid Mechanics & Hydraulic Machines Syllabus (Theory)
Subject code –BEME402T

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Fluid Mechanics & Hydraulic Machines	3	1	-	4	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To classify fluid & their Properties under static and dynamic condition and apply the equations to various hydraulic components and working principles of various measuring devices.
2	To establish the relationship between various properties & apply mathematical treatment to various problems related to fluid system & their Design.
3	To introduce various principles & design of hydraulic Machines i.e. Turbines. Centrifugal and Positive Displacement Pump .
4	To explain the working Principles of Fluid mechanics and their Practical applications in designing the fluid systems
5	To appreciate the application of Similitude in the design of Hydraulic Machines.

Course Outcomes	
After successful completion of this course the student will be able to :	
CO1	Classify and explain fluid their properties, fluid in rest condition, types of flow & flow measuring devices and mathematical application of equations on hydraulic components.
CO2	Explain behavior of fluid in motion condition and application of Bernoullie's equation to fluid flow measuring devices.
CO3	Apply dimensional analysis to design hydraulic machines and different losses of fluid flow through pipes.
CO4	(i) classify different layout of hydro-electric power plant and (ii) analyze design characteristics of hydraulic machines i.e. turbines (impulse and reaction), Pelton turbine , Francis turbine, propeller turbine and Kaplan turbine
CO5	Explain the working principle & design of Centrifugal and reciprocating pump & practical application of similitude & model testing.

Fluid Mechanics & Hydraulic Machines SYLLABUS(Theory)	
Contents	No of hours
UNIT-I Fluid Properties: Types of fluids, Mass Density, Specific Weight, Specific Gravity, Newton's Law of Viscosity, Dynamic Viscosity, Stroke's Theorem, Surface Tension, Capillarity, Compressibility, Vapour pressure. Introduction of Fluid Kinematics, Types of Flow- steady, unsteady, uniform, non-uniform, laminar, turbulent. **Fluid Statics :-** Pressure, Measurement of pressure using manometers, Hydrostatic law, Pascal's law, Pressure at a point, Total pressure, Centre of pressure, Pressure on a plane (Horizontal, vertical, Inclined) and Curved Surfaces, Archimedes's principle, Buoyancy and stability of floating and submerged bodies, Metacentric height	09
UNIT-II Fluid Dynamics Introduction to Navier-Stroke's Equation, Euler equation of motion along a stream line, Bernoulli's equation, application of Bernoulli's equation to pitot tube, venturi meter, orifices, orifice meter. Laminar And Turbulent Flow :- Definition, Relation between pressure and shear stresses, Laminar flow through round pipe, Turbulent flow and velocity distribution. ,	09
UNIT-III Flow Through Pipes Flow Through Pipes :TEL, HGL, Energy losses through pipe, Darcy-Weisbach equation, Minor losses in pipes, TEL, HGL, Moody diagram, pipes in series and parallel, Siphons, Transmission of power. Dimensional Analysis, Dimensional Homogeneity, Rayleigh method & Buckingham's pi – Theorem. Introduction to Similitude and model testing.	09
UNIT-IV Theory of turbo machines Turbo Machine classification**,** Elements of hydro-electric power plant, **Impulse Turbine**:- principles of operation , constructional features, Velocity Diagram and Analysis, Design parameters, Performance characteristics, Governing. **Reaction or pressure Turbine**:- principles of operation, Classification , Degree of reaction, comparison over Pelton Turbine, Draft tube, Cavitation in Turbine, **Francis Turbine**, :- Types, Constructional features, Installations, Velocity Diagram and analysis, Design parameters, Performance characteristics, Governing. **Propeller Turbine, Kaplan Turbine**: -Constructional features, Velocity Diagram and analysis, ,	10
UNIT- V Hydrodynamic pumps:- Centrifugal pumps:- Principle of operation, Classification, Component of Centrifugal Pump, Various heads, Velocity triangles and their analysis, N.P.S.H., Cavitation's in pumps, Installation and operation, Performance characteristics, Introduction to self-priming pumps Reciprocating pump : Basic principle, Classification, Main Components, Slip, Work Done, Indicator Diagram, Cavitation's, Air vessels,,	09

Sr. No.	List of Tutorials
01	Applications based on fluid properties such as block sliding over an inclined plane, capillary phenomenon etc.
02	Study of Manometers
03	Study of stability of floating bodies and submerged bodies
04	Determination of coefficient of discharge of flow meters
05	Verification of Bernoulli's equation
06	Losses in pipes (Hagen Pois. Equation)
07	Design of Pelton Turbine and Francis Turbine
08	Design of Propeller & Kaplan Turbine
09	Design of Centrifugal Pump
10	Design of Reciprocating Pump

References:

Text Books Recommended:

1. Fluid Mechanics, Dr. R.K. Bansal, Laxmi Publication (P) Ltd. New Delhi
2. Engineering Fluid Mechanics, Kumar K.L.,S. Chand & company Ltd. Eurasia
3. Publication House
4. Fluid Mechanics & Hydraulic Machines, R.K. Rajput, S. Chand & Company Ltd.
5. Hydraulic and Fluid Mechanics, Modi P.N. and Seth S.M., Standard Book House.
6. Fluid Mechanics & Fluid Power Engineering – D. S. Kumar, S.K. Kataria & Sons
7. Publications

Reference Books Recommended:

1. Introduction to Fluid Mechanics, James E.A., John and Haberm W.A., Prentice Hall of India
2. Fluid Mechanics, Jain A.K., Khanna Publication
3. Engineering Fluid Mechanics, Garde R.J. and Miraj Goankar, Nem chand & Bros,Roorkee, SCITECH, Publication (India) Pvt. Ltd.
4. Fluid Mechanics and Fluid Power Engineering, Dr. D.S. Kumar, S.K. Kataria & sons
5. Fluid Mechanics, Frank M. White, McGraw Hill Publication
6. Fluid Mechanics, Cengel & Cimbla, Tata McGraw Hill

7. Fluid Mechanics, Streeter V.L. and Wylie E.B., McGraw Hill International Book co.
8. Fluid Mechanics with Engineering Applications, E. Finnemore & Franzini, Tata Mc-Graw Hill
9. Hydraulic Machines-Theory and Design, V. P. Vasandani, Khanna Publishers
10. Fluid Mechanics, A. K. Jain, Khanna Publishers
11. Hydraulic & Compressible Flow Turbo-machines, A. T. Sayers, Mc-Graw Hill

RTM Nagpur University
MECHANICAL ENGINEERING
FLUID MECHANICS & HYDRAULIC MACHINES Syllabus (Practical)
Subject code-BEME402P

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	FLUID MECHANICS & HYDRAULIC MACHINES	-	-	02	01	25	25	50

Course Outcomes	
After successful completion of this Practical course the student will be able to	
CO1	Explain what is Stability condition of floating bodies, Law of conservation of Energy.
CO2	Apply Frictional losses and Hydraulic co-efficient in the pipe flow.
CO3	Estimate the Performance characteristics of Pelton Turbine
CO4	Estimate the Performance characteristics of Francis Turbine & Kaplan Turbine.
CO5	Estimate the Performance characteristics of Centrifugal Pump & Reciprocating Pump.

Sr. No.	List of Practical's
01	To determine the metacentric height of given floating vessel.
02	To verify Bernoulli's theorem.
03	To find friction losses in pipe.
04	To find the value of co-efficient of given venture meter fitted in a pipe.
05	To find the value of co-efficient of Discharge for a given orifice meter.
06	Performance characteristics of Pelton wheel.
07	Performance characteristic of Francis Turbine.
08	Performance characteristic of Kaplan Turbine.
09	Performance characteristic of Variable Centrifugal speed pump
10	Performance characteristic of Reciprocating pump.
11	To find Reynold's Number

Suggested References:

1. Fluid Mechanics, Frank M. White, McGraw Hill Publication
2. Hydraulic Machines-Theory and Design, V. P. Vasandani, Khanna Publishers
3. Fluid Mechanics, John F. Douglas, Pearson
4. Introduction to Fluid Mechanics, James E.A., John and Haberm W.A., Prentice Hall of India

RTM Nagpur University
Mechanical Engineering
Material Science & Engineering (Theory)
Course code- BEME403T

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Material Science & Engineering	3	00	00	3	30	70	100	3hrs.

Sr. No.	Course Objective The objective of this course is–
1	To impart Knowledge for analyzing different Microstructure and Crystalline nature of metals.
2	To impart knowledge of Iron-Iron carbide equilibrium diagram and microstructure of commercial steels and Cast Iron.
3	To provide the knowledge of various heat treatment processes.
4	To impart basic knowledge of powder Metallurgy for Powder metallurgical components.
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Student will be capable to distinguish microstructure and analyze the effect of Crystalline nature of metals, construct and analyze Iron-Iron carbide equilibrium diagram.
CO2	Student will be able to study the commercial steels.
CO3	Student will be able to analyze and implement suitable heat treatment processes.
CO4	Student will be able to analyze the Cast Iron.
CO5	Student will be able to perceive the basics of powder Metallurgy for powder metallurgical components.

Material Science & Engineering (Theory) **SYLLABUS**	
Contents	No of hours
Unit I: **Introduction to materials**, classification of materials. Properties and applications of materials. Crystalline nature of metals, specially microscopic and macroscopic examinations of metals. Alloys and solid solutions, types and their formations, modified Gibbs's phase rule, Lever rule for phase mixtures and their application in system. **Study of equilibrium diagrams** and invariant reactions. Iron-Iron carbide equilibrium diagram, critical temperatures. Microstructure of slowly cooled steels. Estimation of carbon from microstructures; structure property relationship.	10 hrs.
Unit II: Classification and application of plain carbon steels. Examples of alloy steel such as Hadfield Manganese Steel, ball Bearing Steels, etc. Tool Steels – Classification, composition, application and commercial heat treatment practice for HSS, Secondary hardening. Stainless Steels - Classification, composition, application and general heat treatment practice for Stainless Steels. Classification and applications of steels. Effect of alloying elements. ,	10 hrs.
Unit III: Heat treatment and its importance. Annealing, Normalizing, Hardening, Quench Cracks, Hardenability test. TTT diagram and its construction and related Heat Treatment Processes such as Austempering, Martempering, Patenting etc. Retention of Austenite, Effects and elimination of retained austenite, Tempering. Case / Surface hardening treatments such as Carburizing, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening.	9 hrs.
Unit IV: Cast Iron – Classification, White cast Iron, Gray Cast Iron, Nodular Cast Iron, Malleable Cast Iron, Chilled and alloy Cast Iron. (Production route, Composition, Microstructure and applications) Effects of various parameters on structure and properties of Cast Iron, Alloy cast Iron such as Ni-resist, Ni-hard. Non-Ferrous Alloys – Study of non-ferrous alloys such as brasses (Cu-Zn diagram), Bronzes (Cu-Sn diagram), Aluminum Alloys (e.g. Al-Si & Al-Cu diagram), Bearing materials.	9 hrs.
UNIT V: Powder Metallurgy: Powder manufacture and Conditioning, Production of Sintered Structural Components, Self lubricating bearing, Cemented Carbides, Ceramics, Sintered Carbide cutting tools.	9 hrs.

Sr. No.	List of Tutorials
01	Study of microstructure and analyze the effect of Crystalline nature of metals.
02	To construct & study of Iron-Iron carbide equilibrium diagram.
03	Study the commercial steels.
04	Analyze and implement suitable heat treatment processes.
05	Study of Cast Iron.
06	Study of powder Metallurgy for powder metallurgical components.

References:

Text Books Recommended:

1. Material Science & Engineering, V. R. Raghavan,1974.
2. Material Science & Engineering, William Callister,1985.
3. Material Science & Engineering, R. K. Rajput,2009.
4. Material Science & Engineering, An Introduction, 6 th Edition, Donald Askeland, 1984..

Reference Books Recommended:

1. Introduction to Physical Metallurgy 29st revised edition, 2009 Sidney H.Avner McGraw-Hill,1964.
2. Engineering Physical Metallurgy and Heat Treatment 21st revised edition, 1988 Yu Lakhtin Mir publishers, Moscow, Russia.
3. Introduction to Engineering Metallurgy 21st revised edition, 2007 Dr. B K Agrawal Tata Mc-GraHill.
4. Metallurgy for Engineers 4th Revised edition 1987 E C Rollason E. Arnold.

RTM Nagpur University
Mechanical Engineering
MECHANICS OF MATERIAL Syllabus (Theory)
BEME404T

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	MECHANICS OF MATERIAL	3	1	2	4	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	To study different types of stresses, strain and deformation induced in the mechanical components due to external loads.
2	To study Shear force and Bending moment, Stresses in beam under various loading conditions.
3	To understand phenomena of Deflection of Beam and Strain Energy.
4	To design and analyse shaft for various loading conditions
5	To understand design process and failure phenomena of Column & Struts.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Demonstrate fundamental knowledge about various types of loading and stresses induced
CO2	Draw the SFD and BMD for different types of loads and support conditions.
CO3	Estimate the strain energy in mechanical elements. And analyse the deflection in beams.
CO4	Can design shaft for various loading conditions.
CO5	Understand theory of failure and effective designing of column and struct.

MECHANICS OF MATERIAL SYLLABUS (Theory)	
Contents	No of hours
Unit I Concept of simple stresses and strains: Introduction, stress, strain, types of stresses, stress and strain diagram for brittle & ductile material, elastic limit, Hooks law, modulus of elasticity, modulus of rigidity, factor of safety, analysis of tapered rod, analysis of composite section, thermal stress and strain. Longitudinal strain & stress, lateral stresses and strains, Poisson's ratio, volumetric stresses and strain with uni-axial, bi-axial & tri-axial loading, bulk modulus, relation between Young's modulus and modulus of rigidity, Poisson's ratio and bulk modulus Principal stresses and strains:- Definition of principal planes & principal stresses, analytical method of determining stresses on oblique section when member is subjected to direct stresses in one plane in mutually perpendicular two planes, when member is subjected to shear stress and direct stresses in two mutually perpendicular planes, Mohr's circle for representation of principal stresses ,	12 Hrs.
Unit II Shear force and bending moment: - Types of beam (cantilever beam, simply supported beam, overhung beam etc.), Types of loads (Concentrated and UDL), shear force and bending moment diagrams for different types of beams subjected to different types of loads, sign conventions for bending moment and shear force, shear force and bending moment diagrams for beams subjected to couple, Relation between load, shear force and bending moment. Stresses in beams: - Pure bending, theory of simple bending with assumptions & expressions for bending stress, derivation of bending equation, bending stresses in symmetrical sections, section modulus for various shapes of beam sections. Shear stresses in beams: - Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress. ,	10Hrs
Unit III Deflection of beams:- Deflection & slope of cantilever, simply supported, overhung beams subjected to concentrated load, UDL, Relation between slope, deflection & radius curvature Macaulay's method to determine deflection of beam. Strain energy & impact loading: - Definition of strain energy stored in a body when it is subjected to gradually applied load, suddenly applied loads & impact loads. Strain energy stored in bending & torsion . ,	12Hrs

Unit IV Torsion of circular shafts: - Derivation of torsion equation with the assumptions made in it. Torsion shear stress induced in the shaft, when it is subjected to torque. Strength and rigidity criterion for design of shaft. Torque transmitted by solid & hollow circular shaft. Equivalent twisting and bending moment in shaft when it is subjected to bending moment, torque & axial load.	8Hrs
Unit V Column & Struts: - Failure of long & short column, slenderness ratio, assumptions made in Euler's column theory, end conditions for column. Expression for crippling load for various end conditions of column and derivation on column with both ends hinged. Effective length of column, limitations of Euler's formula, Rankine formula.	4Hrs

Sr. No.	List of Tutorials
01	problems on simple and principle stresses
02	problems on Mohr's circle
03	problems on Thermal stresses
04	problems on S.F. & B.M. diagrams
05	problems on Stresses in beam bending
06	problems on shear stresses
07	problems on Macaulay's methods
08	problems on shafts
09	problems on columns & struts

Assignments (Guidelines)

At least one problem on the following topic

1. Stresses in Beams (A two wheeler chassis design concept)
2. Strain energy and deflection (Determination of equivalent load due to impact on the component and its design)
3. Torsion , Column and Struts (Design of frames of solar PV roof top system using software like Stat-Pro)

Note: Preferably The assignments shall be based on live problems. Project based learning may be incorporated by judiciously reducing number of Assignments

References:

Text Books Recommended:

1. Strength of Materials by S. Ramamrutham and R. Narayanan, Dhanpat Rai Publishing Company (P) Ltd, 18th Edition 2017.

2. Strength of Materials by R.K. Bansal, Laxhmi Publications , New Delhi, 6th edition, 2017

3. Strength of Materials by S.S.Rattan, Mcgraw Hill Education, 3rd edition , 2016

Reference Books Recommended:

1. Mechanics of Materials By Beer , Johnston, Dewolf and Mazurek , Tata McGraw- Hill Education , 7th edition , 2015

2. Elements of Strength of Materials by Timoshenko, S.P. and Young, D.H., East West Press, 5th edition, 2011

RTM Nagpur University
Mechanical Engineering
Material Testing Lab- Syllabus (Practical)
BEME404P

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	Material Testing Lab	00	00	2	1	25	25	50

Sr. No.	Course Objective The objective of this course is–
1	Create specimen for metallographic examination.
2	Analyze the microstructure and investigate various properties of ferrous and nonferrous Materials.
3	Test different Engineering Materials.
4	Analyze the hardenability microstructure.
5	Test Cast Iron.
6	To familiarize material behavior under different loading conditions
7	To acquaint with surface hardness measurement method
8	To familiarize with impact test methods for different materials
9	To study and analyze deflection of beams in various loading conditions.
10	To study and understand behavior of material under various loading conditions.

Course Outcomes

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

CO1	Analyze the Microstructure and investigate various properties of ferrorous and Non ferrous Materials . Analyse the stress strain behaviour of materials
CO2	Analyse the effect of tensile, shearing force and can utilized the gained while tackling real life engineering problems for different types of Materials
CO3	Understand Microstructures and their Applications for various uses
CO4	Measure torsional strength , hardness of material
CO5	Incorporate the various important concepts learnt while designing components

****NOTE**: At least 10 Experiments should be included in the Journal-At least 5 from Serial Number 1 to 7 and at least 5 from serial Number 8 to 14). This Practical load shall be equally shared by subject teachers handling subjects Material Science & Engineering and Mechanics of Materials.

Sr. No.	Material Testing Lab -List of practical's
01	To study the Metallurgical Microscopes & Preparation of specimen for metallographic examination.
02	Micro-structural examination of different types of Steels
03	Micro-structural study of White Cast Iron and Grey Cast Iron
04	Micro-structural study of Malleable Cast Iron and Nodular Cast Iron
05	Study of Universal Testing Machine
06	Determination of tensile properties of ductile material
07	Determination of properties of brittle material
08	Compression test on materials
09	Shear test on metals
10	Impact test on materials
11	Torsion test of metal shaft
12	Determination of bending strength by deflection of beam
13	Measurement of hardness with the help of Rockwell Hardness Tester
14	Measurement of hardness with the help of Brinell Hardness Tester

RTM Nagpur University
Mechanical Engineering
Professional Ethics Syllabus (Theory)
BEME405T

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	**Professional Ethics**	3	-	-	3	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	The objective of this course is to inculcate the sense of social responsibility among learners and to make them realize the significance of ethics in professional environment so as to make them a global citizen

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand basic purpose of profession, professional ethics and various moral and social issues
CO2	Analyze various moral issues and theories of moral development
CO3	Realize their roles of applying ethical principles at various professional levels
CO4	Identify their responsibilities for safety and risk benefit analysis.
CO5	Understand their roles in dealing various global issues

Professional Ethics SYLLABUS (Theory)	
Contents	No of hours
Unit I Human Values, Morals, values and Ethics, Integrity, Work ethics, Service learning, Civic virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage ,	08
Unit II Engineering Ethics, Senses of 'Engineering Ethics', Variety of moral issues, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory ,	07
Unit III Engineering as Social Experimentation, Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law ,	07
Unit IV Safety, Responsibilities and rights, Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Collective Bargaining, Professional Rights, Employee Rights	07
Unit V Global issues, Multinational Corporations, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Corporate Social Responsibility	07

References:

Text Books Recommended:

1. Professional Ethics by R. Subramaniam – Oxford Publications, New Delhi.
2. Human Values And Professional Ethics by Jayshree Suresh and B. S. Raghavan, S. Chand Publications
3. Ethics in Engineering by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.
4. Human Values & Professional Ethics by S. B. Gogate, Vikas Publishing House Pvt. Ltd., Noida.
5. Professional Ethics and Human Values by A. Alavudeen, R.Kalil Rahman, and M. Jayakumaran – University Science Press.
6. Engineering Ethics & Human Values by M.Govindarajan, S.Natarajan, and V.S.SenthilKumar-PHI Learning Pvt. Ltd – 2009.
7. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013

RTM Nagpur University
Mechanical Engineering –IV Sem
SPORTS
Course Code- BEME406P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III & IV	SPORTS	0	0	3		00	00	00	00

Sr. No.	COURSE OBJECTIVE
1	Through sports, students should able to build a wide range of abilities and skills such as leadership, confidence, teamwork, patience, self-reliance, trust, and many more which facilitate the overall development of an individual
2	Students should learn to manage time between their lectures, sports, and personal life.

EXPECTATION FROM INSTITUTES

1. Provide sports facilities
2. Provide platforms for participation in events
3. Develop interest for sports amongst students
4. Conduct regular events (every month) in college for all indoor and outdoor sports

RTM Nagpur University
Mechanical Engineering –IV Sem
YOGA
Course Code- BEME406P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III &IV	YOGA	0	0	3		00	00	00	00

Sr. No.	COURSE OBJECTIVE
1	To introduce basic wellness principles and practices of Yoga to students
2	To bring awareness of the fundamentals of Yoga for wellness in their daily lives
3	To bring peace and harmony in the society at large by introducing the Yogic way of life.

EXPECTATION FROM TRAINERS

1. Brief to origin of Yoga,
2. History and Development of Yoga: Vedic Period, Classical Period, Post classical period, Modern Period.
3. Etymology and Definitions of Yoga in classical Yoga texts
4. Meaning, Aim and Objectives of Yoga,
5. Misconceptions about Yoga;
6. True Nature of Yoga;
7. Principles of Yoga;
8. Basis of Yoga.

RTM Nagpur University
Mechanical Engineering –IV Sem
National Service Scheme (NSS)
Course Code- BEME406P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III & IV	National Service Scheme (NSS)	0	0	3	00	00	00	00	00

Sr. No.	COURSE OBJECTIVE
1	1. Understand the community in which they work. 2. Understand themselves in relation to their community. 3. Identify the needs and problems of the community and involve them in problem-solving. 4. Develop among them a sense of social and civic responsibility. 5. Utilize their knowledge in finding practice solutions to individual and community problems. 6. Develop competence required for group-living and sharing of responsibilities. 7. Gain skills in mobilizing community participation. 8. Acquire leadership qualities and democratic attitudes 9. Develop capacity to meet emergencies and natural disasters. 10. Practice national integration and social harmony

EXPECTATION FROM TRAINERS
5. To assist and guide the NSS unit for implementation of NSS programs at college level 6. To advise in organizing camps, training and orientation programs for the NSS volunteers 7. To visit the NSS units for monitoring and evaluation. 8. To ensure implementation of NSS regular activities and special camping programs

RTM Nagpur University
Mechanical Engineering –IV Sem
National Cadet Corps (NCC)
Course Code- BEME406P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III &IV	National Cadet Corps (NCC)	0	0	3		00	00	00	00

ABOUT NCC

1. NCC is the Indian military cadet corps wing of the Indian armed forces.
2. NCC offers training to the students of schools and colleges.
3. This is not compulsory training for all students.

Sr. No.	OUTCOMES EXPECTED
1	During the training of NCC, candidates should get the basic military training. This training should be conducted to develop the interest of young students in all three forces; the army, the navy and the air force of India. Students should be able to check their abilities to join the Indian Defence Services.

Sr. No.	AIM
1	To create an organized, trained and motivated youth, create soldiers for the nation, develop the leadership skills in the youth.

EXPECTATION FROM INSTITUTES

- Create awareness amongst students about NCC
- Make understand the students about the importance of NCC
- Conduct regular Drills and Training exercises
- Conduct Regular exams
- Arrange for Training Camps

RTM Nagpur University- Mechanical Engineering
5TH SEM-Heat Transfer-BEME501T
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 5th Sem Mechanical	**Heat Transfer**	3	1	0	04	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	This course is designed to learn the different modes of heat transfer like conduction, convection & Radiation and formulation of problem based on required application.
2	It will help students to distinguish between steady and unsteady state heat transfer and their applications will enable to calculate heat transfer rate from different geometry of the system under free and forced convection.
3	It also aims to impart knowledge to analyse radiation with and without radiation shield. In addition, it also discusses methods to analyse & design heat exchangers.
4	In all to generate interest in learning to develop in depth understanding in Heat Transfer.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Students will be able to define and compare the different modes of heat transfer and calculation of thermal resistance and heat transfer through plane and composite wall, cylinder and sphere with and without thermal contact resistances.
CO2	Students will be able to apply the concept of internal heat generation for the calculation of heat transfer for plane wall, cylinder and sphere and also learn about various types of fins and their significance in steady state conduction heat transfer calculations. It will also help them to understand the concept of unsteady state heat transfer.
CO3	Students will be able to select and apply appropriate empirical correlations to estimate forced convection and free convection heat transfer, for internal and external flows.
CO4	Students will be able to evaluate heat transfer rate by radiation from ideal and actual surfaces and enclosures of different geometries.
CO5	Students will be able to evaluate heat exchanger performance for the given geometry and boundary conditions and design suitable heat exchanger geometry to deliver a desired heat transfer rate.

SYLLABUS- Heat Transfer	
Contents	No of hours
Unit I Introduction, Basic modes of Heat Transfer, Conduction, Convection & Radiation. Laws of Heat transfer , General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. One dimensional steady state heat conduction equation for the plane wall, cylinder and sphere, Overall heat transfer coefficient. Thermal resistance of composite structure, contact resistance, variable thermal conductivity, critical thickness of insulation. ,	10
Unit II Conduction with internal heat generation for plane wall, Cylinder and Sphere, Extended surface, Types of Fins, Fins of uniform cross section area, temperature distribution and their heat transfer rate, Fin efficiency & Effectiveness. Unsteady state heat transfer, lumped heat capacity analysis, Heisler's charts. Biot's Number, Fourier's Number & its significance. Approximate solution to unsteady state conduction heat transfer by the use of Heisler's chart	09
Unit III Forced convection, Concept of hydrodynamics & thermal boundary layer thickness, local and average heat transfer coefficient. Empirical co-relations for external, internal flows, laminar & turbulent flow through conduits. Free or Natural Convection, Grashof's number, Rayleigh number, flow over horizontal and vertical plate, Empirical co-relations for cylinders and sphere. Introduction to cooling of electronic devices. Heat transfer enhancement using nano fluids. Boiling and Condensation heat transfer: Pool boiling curve and regimes of pool boiling, Film and Drop wise condensation	09
Unit IV Radiation, spectrum of radiation, black body radiation, radiation intensity, Laws of radiation-Kirchhoff, Planck's, Wien's displacement law, Stefan Boltzmann & Lamberts Co-sine law. Emissivity, Absorbtivity, Transmisivity, Reflectivity, Radiosity, Emissive power, Irradiation. Radiation exchange between surfaces, shape factor & its laws, radiation between parallel plates, cylinder & spheres. Radiation shields	09

Unit V Heat exchanger: Detail Classification, Overall Heat Transfer Coefficient, Fouling Factor, LMTD & Effectiveness -NTU method of heat exchanger analysis for parallel, counter flow & cross flow arrangement, Introduction to compact heat exchanger, Heat Pipe. ,	09

Books Recommended:

Text Book

1. Fundamentals of Heat & Mass Transfer, Incropera, F.P., Dewitt, D. P., John Wiley & Sons .
2. Heat Transfer, J.P. Holman, McGraw Hill Book Company, New York.
3. Fundamentals of Heat and Mass Transfer, K. N. Seetharam & T.R. Seetharam, Willey.
4. Engineering Heat and Mass Transfer, M.M. Rathor, Laxmi PublicationsPvt. Ltd.

Reference Book

1. Fundamentals of Heat and Mass Transfer, Venkanna B.K., PHI Publication.
2. Principles of Heat Transfer, Frank Kreith, Harper and Row Publishers, New York.
3. Heat Transfer - A Practical Approach, Yunus A. Cengel, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Heat & Mass Transfer, M.N. Ozisik, Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. Heat & Mass Transfer, R.K. Rajput, Laxmi Publication.

DATA BOOK: 1. Heat & Mass Transfer, Domkundwar, Dhanapat Rai & Sons Publication.
2. Heat & Mass Transfer, C.P.Kothandaraman,PHI publishers.

Sr. No.	List of Tutorials
01	Calculation of thermal resistance and heat transfer through plane and composite wall, cylinder and sphere with and without thermal contact resistances.
02	Calculation of critical thickness of insulation and change in heat transfer for cylindrical and spherical wall.
03	Calculation of heat transfer coefficient and heat transfer rate from plane wall, cylinder and duct subjected to internal and external flow under forced convection.
04	Calculation of heat transfer coefficient and heat transfer rate under free convection
05	Calculation of shape factor for different configuration of grey bodies.
06	Calculation of overall heat transfer coefficient using LMTD and NTU methods

RTM Nagpur University- Mechanical Engineering
5TH SEM -Heat Transfer Lab (BEME501P)
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
B.Tech 5th Sem Mechanical	**Heat Transfer Lab**	-	-	02	1	25	25	50

Sr. No.	Course Objective The objective of this course is–
1	To demonstrate and perform basic principles finding thermal conductivity of various materials like asbestos, brass etc.
2	To demonstrate basic method for determination of overall heat transfer coefficient of composite slabs.
3	To perform experimentation for determination of heat transfer coefficients in free and forced convection.
4	To demonstrate basic method for determination of emissivity of grey body and Stefan Boltzmann's constant.
5	To perform experimentation for determination of heat transfer coefficients, effectiveness and heat transfer rates in Heat Exchangers

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Students will be able to determine the heat transfer rates through various cross-sections and mediums in different modes.
CO2	Student will be able to acquire, tabulate, analyze experimental data, and draw interpretation and conclusions
CO3	Student will be able to calculate radiation heat transfer and utilize that knowledge in designing any heat transfer application .
CO4	Student will be able to understand heat exchanger analysis.

Sr. No.	List of Practical's -Heat Transfer Lab
01	To determine the thermal conductivity of insulating material.
02	To determine the thermal conductivity of metal bar.
03	Determination of thermal conductivity of composite wall.
04	Determination of Stefan Boltzmann constant.
05	Determination of heat transfer coefficient in natural convection for vertical tube.
05	To determine heat transfer coefficient in forced convection for fluid flowing through a duct
06	Determination of temperature distribution & heat transfer rate from fin under free and forced convection.
07	Determination of emissivity of non-black body.
08	To determine the effectiveness of a concentric tube heat exchanger.
09	To determine the critical heat flux.
10	Determination of heat transfer rate in unsteady state heat transfer.
11	To determine the heat transfer coefficient in filmwise and dropwise condensation.
12	Determination of performance of shell and tube heat exchanger using computer-based setup
12	Minimum 2-3 virtual experiment to be conducted.
13	Study of various types of Heat Exchangers.
14	Study of Heat Pipe.

Note : At least 8 practicals from the above list are expected.

RTM Nagpur University- Mechanical Engineering
5TH SEM-Energy Conversion -I -BEME502T
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 5th Sem Mechanical	**Energy Conversion-I**	3	1	-	4	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	To expose the students to the practical applications of engineering thermodynamics & working of steam power plants.
2	To gain the knowledge of various components of the thermal power plant like boiler, nozzles, turbines and condensers and will be able to evaluate the performance parameters of these components.
3	To understand the concept of utilizing residual heat in thermal systems
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Explain, classify, analyze layout of power plant, cogeneration principle of steam generators (i.e. Boilers), boiler mountings & accessories and evaluate performance parameters of boiler.
CO2	Explain the concepts of fluidized bed boilers and various draught system and evaluate performance parameters of natural draught system(i.e. chimney)
CO3	Explain the importance of steam nozzle and determine its throat area, exit area, exit velocity. Also compare impulse and reaction steam turbines and explain the concept of governing of steam turbine
CO4	Explain the methods of compounding of steam turbine, various energy losses in steam turbine and able to draw velocity diagrams of steam turbine blades to analyze the angles of the blades, work done, thrust, power, efficiencies of turbine.
CO5	Explain, classify steam condensers, cooling towers and evaluate performance parameters of surface condenser.

Syllabus- Energy Conversion–I (Theory) , Mechanical Engineering, V Sem	
Contents	No of hours
Unit I Introduction to layout of thermal power plant, Coal handling system and ash handling systems. Classification of steam generators (i.e. Boilers), comparison of fire tube & water tube boilers, high pressure boilers, boiler mountings and accessories. Principle of steam generation, necessity of water treatment, Performance of steam generators: Evaporation capacity, equivalent evaporation, boiler efficiency and preparation of Heat balance sheet of boiler. Cogeneration: Introduction to cogeneration, its need, working principle and applications. Topping cycle and bottoming cycle.	12
Unit II Draught and its classification, calculations for chimney height, chimney diameter & efficiency. Condition for maximum discharge. Fluidized bed boiler: Bubbling fluidized bed boilers, circulating fluidized bed boilers (Elementary treatment expected)	8
Unit III Steam nozzles: Adiabatic expansion in nozzles, maximum discharge, critical pressure ratio and effects of friction, calculation of throat, exit areas and exit velocity of nozzle, supersaturated flow, Wilson Line. Steam turbines: Working principle of steam turbines, classification of steam turbines, and comparison of impulse and reaction turbine, governing of steam turbines. ,	8
Unit IV Compounding of steam turbines, Energy losses in steam turbines, flow of steam through turbine blades, reheat factors, velocity diagrams, graphical and analytical methods, work done, thrust and power, dimensions and proportioning of the blades, steam turbine efficiencies, condition for maximum efficiencies. (Analytical Treatment on Impulse turbine, Reaction turbine and two stage impulse turbine is expected) ,	8
Unit V Steam condensers: Classification of condensers, quality and quantity of cooling water required, calculations for surface condenser, Dalton's law of partial pressure, sources of air leakages and air removal, air ejectors. Cooling towers: Natural draught and forced draught cooling towers, cooling ponds ,	8
TOTAL HOURS	44

Sr. No.	List of Tutorials- Energy Conversion –I
01	Two problems on determination of factor of evaporation, equivalent evaporation and boiler efficiency of steam generators (i.e. boilers.)
02	Two problems on preparation of Heat balance sheet of boilers.
03	Two problems on determination of height and diameter of chimney.
04	Two problems on calculation of throat, exit areas and exit velocity of nozzle.
05	One problem on metastable or supersaturated flow through nozzle
06	Two problems on determination of blade angles, work done, thrust, power, efficiencies of Impulse turbine.
07	Two problems on determination of work done, thrust, power, efficiencies of Reaction turbine.
08	One problem on determination of power and efficiencies of two stage Impulse turbine
09	Two problems on calculation of performance parameters of surface condenser.

References:

Text Books Recommended:

1. A Course in Power Plant Engineering, Arora & V.M. Domkundwar, Dhanpat Rai & Sons
2. Thermal Engineering, P.L. Ballaney, Khanna Publications.
3. Thermal Engineering, R. K. Rajput, Laxmi publications.
4. Thermal Engineering, M.M. Rathode, TMH publication.
5. A Course in Thermal Engineering, Anand Domkundwar, C.P. Kothandaraman, S.Domkundwar, Dhanpat Rai & Sons.

.**Reference Books Recommended:**

1. Thermal Engineering, Mathur & Mehtra, Jain Brothers Publications, New Delhi.
2. Heat Engineering, V.P. Vasandani & D.S. Kumar, Metropolian Book Publishers.
3. Power Plant Engineering, A.K. Raja, Shrivastava and Dwivedi, New age International Publishers.
4. Fluidized Bed Combustion, S. Oka and E. Anthony, Marcel Dekker Inc.
5. Power Plant Engineering, M. M. EI- Wakil, McGraw Hill International.
6. Charles H Butler: Cogeneration" McGraw Hill.
7. Donald Q. Kern, "Process Heat Transfer", Tata Mc Graw Hill.
8. Sydney Reiter "Industrial and Commercial Heat Recovery Systems" Van Nostrand Reinhols.

RTM Nagpur University- Mechanical Engineering
5th Semester
Design of Machine Elements –(BEME503T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 5th Sem Mechanical	**Design of Machine Elements**	3	1	-	4	30	70	100	3 Hours

Sr. No.	Course Objective The objective of this course is–
	To study the basic principles of mechanical components design based on strength and rigidity using design data, various standards, codes, etc. and prepare component drawings.

Course Outcomes

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

CO1	Apply principals of static loading for design of Cotter joint, Knuckle joint
CO2	Design bolted, welded joints, power screws & pressure vessels
CO3	Design the power transmission shaft & coupling
CO4	Design components subjected to fatigue or fluctuating stresses. Also, will be able to apply principles for determining bending stresses for desing of curved beams e.g. crane hook, C-Frame.
CO5	Design clutches, brakes and springs

Syllabus- Design of Machine Elements (Theory,) 5th Semester , Mechanical Engineering	
Contents	No of hours
Unit I Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Design consideration of casting and forging, Basic principle of Machine Design, Modes of failures, Factor of safety, Design stresses, Theories of failures (Selection in the process of designing), Standards, I.S. Codes, Preferred Series and Numbers **Design of Joints against static loads**: Cotter joint and Knuckle joint ,	**[10 hrs]**
Unit II Design of bolted and welded joints under axial and eccentric loading conditions. Design of power screw: Thread forms, multiple threaded screws, terminology of power screw, design of screw jack. Design of Cylinder & Pressure Vessels: Types of pressure vessel, stresses induced in pressure vessel, Lame's, Clavarino's and Bernie's equations. Design of cylindrical & spherical pressure vessels. Design of nut, bolt, gasket & covers for pressure vessel.	**[10 hrs]**
Unit III **Design of shaft** for power transmission, static and fatigue criteria for shaft design, ASME codes for shaft design, Design of keys. Design of rigid and flexible coupling.	**[10hrs]**
Unit IV: **Design against fluctuating loads:** variables stresses, reversed, repeated, fluctuating stresses. Fatigue failure: static and fatigue stress concentration factors, Endurance limit- estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria, Fatigue design under combined stresses. **Curved Beams:** Assumptions made in the analysis of curved beams, Design of curved beams, bending stresses in curved beams, such as crane hook, C-frame, etc.	**[8 hrs]**
Unit V: **Design of clutches and brakes:** Single and multiple plate clutch, constant wear and constant pressure theory for plate clutches, Internal and external shoe brakes and band brakes. Introduction to disc brakes and its design concepts. **Design of Springs:** Spring material, Helical compression & tension springs under static and variable loads, Leaf spring, Laminated Springs.	**[10hrs]**

Sr. No.	List of Tutorials
01	Numerical on Design against static loads: Cotter joint and Knuckle joint
02	Numerical on design of bolted and welded joints
03	Numerical on design of power screw
04	Numerical on design of Cylinder & Pressure Vessels
05	Numerical on design of shaft, keys and coupling
06	Numerical on design of coupling
07	Numerical on Design of clutches and brakes
08	Numerical on Design of springs under static and variable loads.

Assignment (Guidelines)

1. Design exercise in the form of design calculations with sketch and or drawings on following machine components
   a) Bolted and welded joints
   b) Design against fluctuating loads (finite and infinite life)
   c) Shaft and coupling design
   d) Screw Jack
2. Comparative study and analysis of disc brakes used in motorcycles of different makes (at least 4)

References:

Text Books Recommended:

1. Design of Machine Elements, B.D. Shiwalkar. Central Techno publications
2. Design of Machine Elements, V. B. Bhandari., McGraw Hill education.
3. Design of Machine Elements, Sharma & Purohit, PHI.
4. Design Data book, B.D. Shiwalkar, Central Techno publications.
5. Mechanical Engg. Design, Shigley J E, TMH.
6. Design Data Book, PSG.

Reference Books Recommended:

1. Mechanical Design Analysis, M. F. Spotts, Prentice-Hall.
2. Machine Component Design, Robert C. Juvinall, Kurt M. Marshele, Wiley.
3. Machine Design, Maleev& Hartman, CBS publishers.
4. Hand book of Machine Design, Shigley&Mischke, McGraw Hill.
5. Machine Design, Robert L.Norton, Pearson.
6. The Principles of Design, Nam P. Suh, McGraw Hill

RTM Nagpur University- Mechanical Engineering
5th Semester
Design of Machine Elements –(BEME503T)
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
B.Tech 5th Semester Mechanical	**Design of Machine Elements**	-	-	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Design Cotter joint / Knuckle joint / Turn buckle/ crane hook, C-frame
CO2	Design bolted and welded joints, power screw and Cylinder & Pressure Vessels
CO3	Design the shaft, coupling, clutches and brakes
CO4	Design the spring under static and variable loads

Sr. No.	Syllabus- Design of Machine Elements (Practical),5th Sem, Mechanical Engineering
01	Design of Cotter joint, Knuckle joint
02	Design of bolted joints under axial and eccentric loading conditions.
03	Design of welded joints under axial and eccentric loading conditions
04	Design of power screw
05	Design of Cylinder & Pressure Vessels.
06	Design of power transmission shafts.
07	Design of Couplings
08	Design of crane hook, C-frame
09	Design of clutches and brakes.
10	Design of springs under static and variable loads..
NOTE: **Design problems (at least 8 problems should be included in the Journal)**	

Suggested References:

1. Design Data book, B.D. Shiwalkar, Central Techno publications
2. Design Data Book, PSG
3. Design of Machine Elements, V.B.Bhandari, McGraw Hill.

RTM Nagpur University- Mechanical Engineering
5TH SEM-Industrial Economics & Management-BEME504T
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 5th Sem Mechanical	Industrial Economics & Management	3	-	-	03	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
01	This course is designed to familiarize the learners with important economic terminologies and key industrial concepts and to create awareness about functions of Industrial management and the concept of marketing and financial management.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the concept of demand and supply and its relationship with the price
CO2	Relate various factors of production with reference to different economic sectors
CO3	Analyze the causes and effects of inflation and understand the market structure
CO4	Acquire knowledge of various functions of management and marketing management
CO5	Perceive the concept of financial management for the growth of business

SYLLABUS- Industrial Economics & Management-BEME504T	
Contents	No of hours
Unit I Industrial Economics: Law of demand, Demand analysis, Types of demand, Determinants of demand, Supply, Law of diminishing marginal utility, Elasticity of demand, Types of elasticity of demand. ,	08
Unit II Factors of production, Firm and Industry, Law of return, Cost concepts, Fixed variable, Average, Marginal and Total cost, Depreciation and methods for depreciation, direct and indirect taxes	08
Unit III Inflation, effect of inflation, Monetary and fiscal measures to control inflation, deflation, Market and market structures, Perfect competition, Monopoly, Monopolistic competition, Oligopoly, Concept & overview of share market, Effect of share market on economy, Share market terminologies	08
Unit IV Definition, nature and scope of management, functions of management, Meaning and concepts of Marketing management, Marketing Mix, Channels of distribution, Advertising and sales promotion.	08
Unit V Meaning, nature and scope of financial management , Brief outline of profit and loss account, balance sheet, Budgets and their importance, Types of budgets- Rigid and flexible budgets.	08

Books Recommended:

Text Books

1. Modern Economics, H. L. Ahuja, S.Chand Publishers
2. Modern Economic Theory, K. K. Dewett., S. Chand Publishers
3. Engineering Economics, D. N. Dwivedi, A. Dwivedi, Vikas Publishing House
4. Industrial Management I.K. Chopde, A.M. Sheikh
5. Business Organization and Management S.A. Sherlekar

RTM Nagpur University- Mechanical Engineering
5TH SEM- Organizational Behaviour and Entrepreneurship Development -BEME505T
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 5th Sem Mechanical	Organizational Behavior and Entrepreneurship Development	3	-	-	03	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
01	The objective of the course is to create awareness among learners about the various essential aspects of organizational behavior and to impart know how on entrepreneurship development.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the concept and importance of organizational behaviour
CO2	Acquire the knowledge of interpersonal behaviour and transaction analysis
CO3	Know different traits and theories of personality
CO4	Acquire a know-how on entrepreneurship development and its ecosystem
CO5	Get the knowledge of various sources of finance

SYLLABUS- Organizational Behaviour and Entrepreneurship Development	
Contents	No of hours
Unit I Concept of organization behavior, Importance of organization behavior, Key elements of organization behavior, scope of organizational behaviour.	08
Unit II Nature and meaning of interpersonal behavior, concept of transaction analysis, benefits and uses of transaction analysis, Johari window model.	08
Unit III Definition and meaning of personality, importance of personality, theories of personality, personality traits.	08
Unit IV Concept of entrepreneurship, characteristics of an Entrepreneur, types of Entrepreneurship, Functions of Entrepreneurs, factors affecting the growth of entrepreneurship, Women entrepreneurship in India, Problems and challenges of women entrepreneurs, Government's support system to develop women entrepreneurship.	08
Unit V Sources of financing the enterprise, Concept of fixed and working capital, factors influencing the requirement of working capital, Concept of start-up and start-up echo system, Concept of product life cycle.	08

Books Recommended:

Text Books

1. Organizational behaviour by MN Mishra, published by S.Chand.
2. The human side of organization by Michale Drafke, published by Pearson education.
3. Management and Organizational behaviour by Laurie.J. Mullins, published by Pearson education.
4. Organizational behaviour by K. Aaswathappa, Published by Himalaya publications.
5. Entrepreneurial Development By, S. S. Khanka S. Chand & Co. Ltd. New Delhi, 1999.
6. Entrepreneurial Development. By, S.Anil Kumar. New Age International.
7. Small- Scale Industries and Entrepreneurship, By, Dr. Vasant Desai, Himalaya Publication.
8. Management of Entrepreneurship. By, N.V.R. Naidu, I.K. International Pvt Ltd.

RTM Nagpur University- Mechanical Engineering
5TH SEM-(Open Elective –I)
Automobile Engineering -I -BEME505T
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 5th Sem Mechanical	**Open Elective - I Automobile Engineering**	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course are–
1	To make the students conversant with fundamentals of automobile systems
2	To develop competencies in the performance analysis of vehicle.
3	To understand the emerging trends in electric vehicles, Hybrid vehicles and fuel cell vehicles
4	To make the students conversant with Automobile Safety Considerations Electrical Systems and Modern Developments in Automobiles.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Demonstrate the vehicle construction, chassis, fuel supply system, lubrication system and cooling system in automobile.
CO2	Illustrate the principle and working of Transmission system and clutch, gear box, rear axle drives, fluid flywheel, torque converter.
CO3	Identify the steering, suspension system and brake system.
CO4	Understand the applications of electrical/electronic system of automobile and wheels, tyres.
CO5	Explain the concept of electric vehicles, Hybrid vehicles, fuel cell vehicles and vehicle pollution norms. Appraise the automobile safety system and recent development in automobiles.

Syllabus- Automobile Engineering- Open Elective - I	
Contents	No of hours
Unit I: **Introduction:** Classification of automobiles, Major components and their functions. Chassis, different vehicle layouts. **Engine Power Plant:** Constructional features of different types of engines used in automobiles. Fuel supply systems, cooling systems, lubrication systems.	7
Unit II **Transmission system:** **Gear Box:** Necessity of transmission, principle, types of transmission, sliding mesh, constant mesh, synchromesh, transfer gear box, gear selector mechanism. Torque converter, semiautomatic and automatic transmission. Propeller shaft, universal joint, Hotchkiss drive, torque tube drive. Differential and its need. Rear axles and Front axles. **Clutch:** Necessity, requirements of a clutch system. Types of Clutches, centrifugal clutch, single and multi-plate clutch, fluid clutch.	8
Unit III **Steering systems:** Principle of steering, steering geometry and wheel alignment, Power Steering. Under steer, Over-steer. electronic power steering **Suspension systems:** Need, Function of spring and shock absorber, conventional suspension, Independent, suspension System, Active suspensions. **Brakes:** Function, Classification, Basic Components. Drum Brakes, Disc Brakes, Hydraulic brakes, Air Brakes, ABS.	8
Unit IV **Electrical Systems:** Battery, magneto and electronic ignition systems, horn, side indicator and wiper Automobile air-conditioning. Automotive Llighting circuit, Importance, types and specifications, LEDs, Reflectors. **Automotive Electronics:** Dashboard instrumentation, Sensors used in automobiles, ECU. **Wheels and Tyres:** Types of wheels, wheel dimensions, tyre, desirable tyre properties, types of tyres, comparison of radial and bias-ply tyres, factor affecting tyre life.	7

Unit V Electric vehicles, components of EV, EV Batteries, EV Chargers. Hybrid vehicles, types of hybrids and Fuel cell vehicles. Alternative energy sources, CNG, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles. **Vehicle Pollution Control:** cause and types of Emissions from Vehicle, Euro and Bharat Stage norms, Methods to reduce vehicular pollution, after treatment devices, EGR and Catalytic Converter. **Automobile Safety Considerations and Modern Developments in Automobiles:** Requirements of automobile body, Vehicle Safety Necessity, active and passive safety, Restrain Systems (seatbelts), Air Bags, crash worthiness. Recent advances in automobiles such as, collision avoidance, intelligent lighting, intelligent highway system, navigational aids, Automatic Cruise Control and Parking Assistance system.	8

References:

Text Books Recommended:

1. Automobile Engineering Vol. I & II, Kirpal Singh, Standard Publishers, Delhi
2. Automobile Engineering, R.K.Rajput, Luxmi Publications, New Delhi
3. Automobile Engineering R.B. Gupta, Satya Prashan, New Delhi
4. Course in Automobile Engineering, Sharma R. P, Dhanpat Rai and Sons, New Delhi, 1998.

Reference Books Recommended:

1. Automobile Mechanics, Crause, W.H., Tata McGraw Hill, New Del hi, 2007.
2. Vehicle and Engine Technology, Heinz Heisler, Arnold, London, 1999.
3. Automotive Engines, Srinivasan S., Tata McGraw Hill, New Delhi, 2001.

RTM Nagpur University- Mechanical Engineering
5th Sem- Open Elective-I
Project evaluation and Management –(BEME505T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 5th Sem Mechanical	Open Elective-I Project evaluation and Management	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To develop an understanding towards a structured approach for every unique project undertaken in the industrial context about its need, concept, tools and techniques of project management approach
2	To develop working knowledge of the technical and financial aspects of project management decisions. Increase awareness and strengthen skills in applying participatory methods to project management.
3	Understand the project management lifecycle and be knowledgeable on the various phases from project initiation through closure.
4	Develop detailed project plan to include: Defining a project's scope and tasks, estimating task resource needs, assessing project risk and response strategies, a communications plan, and more.
5.	Understanding the critical role of an strong project manager played in project success.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Utilize the use of a structured approach for each and every unique project undertaken including utilizing project management concepts, tools, and techniques.
CO2	Apply participatory methods to project management.
CO3	Do network scheduling and network planning
CO4	Manage lifecycle on the various phases from project initiation through closure.
CO5	Do estimation of project Costs, Earned Value Analysis, Monitoring Project Progress, Project Appraisal.

Syllabus-Project evaluation and Management (Open Elective -I) 5th Sem ,Mechanical Engg	
Contents	No of hours
Unit I Definition & Characteristics of Project Performance Parameters: Time, Cost & Quality. Classification of Projects: Sector based, Investment based, Technology based, Cause based, Need based - Balancing, Modernization, Replacement, Expansion & Diversification. Project Life Cycle Phases – Concept/Initiation Phase: Parameters Involved in Project Identification. Sources of New Project Ideas. Governmental Framework for Identification of Opportunities, Incentives from state & central govt.; Import-substitution projects. ,	9
Unit II Project Conceptualization & Feasibility Analysis Project Definition Phase: Project Formulation & Feasibility. Types of Feasibility Studies – Pre-feasibility, Support/Functional Feasibility Study. Preparation of Project Feasibility Report & Specification; Aspects of Project Feasibility Managerial/Organization: Promoters Background, Criteria of Evaluation, Marketing/Commercial: Demand & Supply, Competition, Market Survey, Porter's 5 Forces, Operational/Technical: Process, Technology, Location, Capacity, Labour, Raw Material & Utility Availability. Financial: Cost of Project, Means of Finance, Financial Projections – Profit & Loss Account, Balance Sheet, Funds Flow Statement, Cash Flow Statement, Schedule of Fixed Assets, Schedule of Term Loans. Socio-Economic: Socio-Cost Benefit Analysis. Effective Rate of Protection, Domestic Resource Cost. ,	9
Unit III Project Planning- Development of Project Network; Project Representation; Consistency and Redundancy in Project Networks; Project Scheduling- Basic Scheduling with AO-A Networks; Basic Scheduling with A-O-N Networks; Project Scheduling with Probabilistic Activity Times. Planning & Organization Phase: Project Planning, Scheduling & Monitoring, Statement of Works, Project Specifications, Work Breakdown Structure, Network Analysis & Duration Estimating Network Diagrams – PERT/CPM, Estimate Activity Times, Milestone Scheduling. Resource Leveling, Resource Smoothening, Project Crashing. ,	9

Unit IV Project Cost Estimation: Need, Causes of Cost & Time Overruns. Nature of Cost Estimates, Types of Project Cost Estimates, Estimation of Manpower & Utilities. Project Budgeting & Control, Earned Value Management System: Concept of AC, PV, EV, Variances, etc. Contract Management: Responsibility Sharing Matrix, Types of Contract Payments, Risk Factors in Contracts – Contractor & Owner. Project Management Information System and Control, Management Pitfalls. ,	9
Unit V Project Implementation & Control Implementation Phase: Activities Involved: Erection & Commissioning, Installation, Trial Runs & Commencement of Commercial Production. Cleanup/Shutdown Phase: Handover to Client, Settlement of Accounts. Project Risk Management, Responsibility Sharing Matrix, Critical Chain Project Management – Critical Path vs Critical Chain, Concept of Buffers – Project buffer, resource buffer, feeding buffer. ,	9

Sr. No.	List of Tutorials
01	Writing an Exercise with Latest Software.(Ms Project) a complete project step by step on any one industry.

References:

Text Books Recommended:

1 Narendra Singh; Project Management & Control; Himalaya Publishing House, Mumbai
2 S. Choudary, Project Management, Tata McGraw Hill
3. Prasanna, C; Projects: Preparation, Appraisal, Budgeting & Implementation, Tata Mc-Graw Hill, New Delhi, (1987).
4 Chas R.B., Aqulino, N.J. and Jacob,F.R., Production and Operations Management: manufacturing and services, Tata McGraw Hill, New Delhi (1999).

Reference Books Recommended:

1. Maylor H, Project Management, Pearson Education Asia, New Delhi, (2009).
2. Cleland D , Project Management, Tata Mc-GrawHill, New Delhi, (2007).

RTM Nagpur University- Mechanical Engineering
5th Semester
Industrial Visit –(BEME506P)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 5th Sem Mechanical	**Industrial Visit**	-	-	2	1	50	--	--	1hr

Sr. No.	Course Objective The objective of this course is–
1	Industrial visits provide the students with an opportunity to learn practically through interaction, working methods and employment practices. It gives the students an exposure to current work practices as opposed to theoretical knowledge being taught at their college classrooms

Course Outcomes	
After the successful completion of this course the students are able to:	
CO1	Opportunity to interact with Industry Experts
CO2	Learning experience.
CO3	Enhanced employability and PPO's.
CO4	Interpersonal skills enhancement.
CO5	Day off from the usual melancholy.

Contents
A student pursuing a certain degree will be taken to companies or industries related to their field for a visit and there the students will be exposed briefly to the procedures, processes, work environment, management efforts taking place in that industry
Students should meet industry leaders, professionals, entrepreneurs, policymakers, and corporates who share their wisdom, learning, and experiences. Through these interactions students should develop leadership qualities, management skills, and learn about the industry working. Industry interaction can be helpful in updating the curriculum when there are significant changes in prevalent technologies; also, the faculty members get to know about the industry's latest trends.
Educational tours to industries provide an opportunity for students to see and experience real workstations, plants, machines, systems, assembly lines, and interact with highly trained and experienced personnel. Students should present a report on the industry he/she visits.
For students, such trips open many doors for corporate training and internships, which in turn increase the students' employability.
During the industrial visits, the students get an opportunity to experience how professionals live, learn about various management concepts like Just In Time or Lean manufacturing and how they are put into action. It is not easy to manage hundreds of skilled and unskilled workers at the same time and meet the stringent quality norms and production targets of the company. How managers, production engineers, employees work in tandem to achieve a common target is a management lesson in itself. Students are supposed to understand them.
Industrial trips help students to enhance their interpersonal, communication skills, and teamwork abilities. These visits have, time and again, proved to be an excellent platform for networking as the students interact and connect with the corporates via official social media platforms like Facebook, Linked In, and Twitter. These educational/ industrial trips also help the students identify their learning towards a branch and decide their future work areas like marketing, finance, operations, IT, HR, etc.

Checklist

For Teachers:

1. Have you given the student some background about the organization?
2. Have you clearly defined the learning objectives to the organization and the students?
3. Have you ensured the plan for the day with the students and the learning procedure including the timings?
4. Have you elaborated the risk assessments to the students and the safety procedure along with the behavior to be followed?
5. Have you ensured the permission from the Parents and the Guardians regarding the visit?
6. Prepared the students on the personal objectives?
7. Have you helped students form questions to be asked in the industry?
8. Have you introduced the students to the scientific topics that they will encounter on the visit?

Checklist for Students:

1. How conducive is the working environment
2. What type of organization is this?
3. Hierarchical structure in the organization
4. Products handled
5. Where is the workplace located?
6. How are the desks arranged?
7. Is it an open office or a closed office?
8. What is the noise level in this industry or factory?
9. What are the staff benefits?
10. Do the employees appear happy and engaged?
11. What are the age level and the gender balance?
12. What are the various departments and the varied availabilities?
13. Commutation mode to employees?

14. Are the employees challenged by their work?
15. What is the company culture followed?
16. The dress code maintained by the employees of both the genders?
17. Could you see yourself as a prospective employee of the company in the future?
18. Does this sector of education fascinate you?

Checklist for Organizing Team:

• Ensure that the college and the company are well aware of the Number of students', their age.
• Purpose of the visit is made clear to both the parties and MOU is signed by the company and the school to comply with the rules of the organizing team.
• Do you understand the learning outcomes for the students and have a clear idea of how the visit will meet these?
• Have you carried out a risk assessment and undertaken any other health and safety responsibilities
• Have you got a clear understanding of the plan for the day and the timings of activities?

NOTE

1. Students FEEDBACK form and Report must be collected and kept for reference during committee visits

2. A detailed report of all industries visited by the students must be prepared and kept for reference during committee visits

3. Minimum 70% of total teaching staff should have visited at least one company with students

RTM Nagpur University- Mechanical Engineering
5TH SEM-Performing Art (BEME507P)
Syllabus (Theory)- Mandatory Course

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech . 5th Sem Mechanical	**Performing Art**	00	00	03	00	-	-	-	-

Sr. No.	Course Objective The objective of this course is–
1	A short course in art is at the heart of this course and is intended to open the way for students to "think outside the square" – or more precisely, through art to find themselves in that challenging but potentially wonderful place outside their own personal square.

Course Outcomes

An Arts and Science course helps the students to empower themselves with problem solving skills. The ability to analyze things and communicate them in the right way is taught. These skills are very much essential to get employed in reputed companies and most of the companies prefer candidates with the mentioned skills. The students also have a variety of career options to choose for the future

Performing Art –Suggested Activities. However Institutes are free to design their own course as per their convenience

LEVEL -1

Music	Dance	Drama
1. Raga studies	1. History of Dance	1. Acting
2. Western music	2. Choreography	2. Basic vocal practice
3. Hindustani music	3. New media	3. Communication skills
4. Study of Tala	4. Performance Practice	4. Yoga
5. Shastra	5. Indian Culture	5. Direction
6. Rabindra sangeet	6. Techniques of Dance	6. Event management
7. Folk music	7. Movement Techniques	7. Computer skills
8. World music	8. Dance on Camera	8. Indian theatre
		9. History of theatre
		10. Western theatre
		11. Camera, light, sound
		12. Filming concepts
		13. Projects on short films
		14. TV production
		15. Film Theories

LEVEL -2

Music	Dance	Drama
1. Analytical study of raga 2. Raga classification system 3. Indian aesthetics 4. Comparative aesthetics 5. A critical study of specified raga 6. Composition forms of Indian vocal music	1. History of dance 2. Dance and sculpture 3. Kathak 4. Bharatnatyam 5. Rasa & Nayak Nayika Bheda 6. Traditional folk dance 7. Dance and Sanskrit treaties	1. Theatre game & physical exercises 2. Voice speech 3. Acting on stage 4. Play production 5. Classical Indian theatre 6. Direction zones 7. Stage management 8. Acting on camera 9. TV and film production 10. Children's theatre 11. Folk performances 12. Play production 13. Improvisation, Mime and choreography

RTM Nagpur University-Mechanical Engineering
6th Semester
Automation In Production (BEME601T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	**AUTOMATION IN PRODUCTION**	3	1	0	4	30	70	100	3Hrs

Sr. No.	Course Objective The objective of this course is–
1	To develop the ability to analyze any engineering problem and apply logic for getting solution so as to develop decision making skill in current manufacturing environment
2	To get the understanding regarding how automation is used to increase production
3	To develop ability to understand latest automation in production like CNC, Robotics etc.
4	To develop understanding of various techniques like FMS,CAPP and CAD/CAM

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Get Acquainted With Automation, Its Type's ,Strategies , Assembly Line Balancing And Its Analysis, Methods Of Work Part Transport
CO2	Recognize fundamentals and constructional features of N.C, CNC and D.N.C machines and prepare a CNC program for given part.
CO3	Get Acquainted With The Robotic Configuration, Types Of Links, Joints, Grippers, Industrial Robotics And Robot Applications.
CO4	Cultivate Information About Automated Material Handling Systems, Automated Storage And Retrieval System (AGVS,AS/RS) Its Analysis
CO5	Get Acquainted With Automated Inspection (CAPP, CAQC, CMM) And Group Technology.
CO6	Recognize CAD/CAM,CIM,FMS, Understand The Concepts Of Shop Floor Control

SYLLABUS- **Automation In Production (BEME601T)**	
Contents	No of hours
Unit I Automation Automation -Definition, types, reasons, strategies for automating, arguments for and against automation. Production system, Difference between Mechanization and automation, USA principle, automation migration strategy, Automated Flow Lines- Methods of work part transport, Buffer storage. Analysis of flow lines and of transfer lines without storage, manual assembly lines. Line Balancing Problem, Methods of line balancing. (Largest Candidate Rule & RPW only)	9 Hrs
Unit II Numerical Control Production Systems and Industrial Robotics Numerical Control Production Systems- Basic concepts, coordinate system and machine motion- Types of NC systems- Point to point, straight cut and continuous path. Machine control unit and other components, .NC part programming, NC words, methods of part programming, manual part programming: APT programming, Direct numerical control. Computer numerical control. Adaptive control. Applications and economics of NC.(only APT programming should be asked in theory and manual programming in practical performance) Industrial Robotics - Introduction, robot anatomy, robot control systems, accuracy and repeatability and other specifications, end effectors,. Robot applications- ,	9Hrs
Unit III Automated material handling & storage: Automated material handling & storage-Conveyor systems : Automated Guided Vehicle Systems -Types: - Driverless trains, AGVS pallet trucks, AGVS unit-load carriers. Vehicle guidance & Routing, Traffic control & safety, System management, Analysis of AGVS systems, AGVS applications. Automated Storage & Retrieval System -Types :- Unit load AS/RS , mini load AS/I{S , man on board AS/RS , automated item retrieval system, deep lane AS/RS -Basic components & special features of AS/RS , Carousel storage systems , Work in process storage, (quantitative analysis is expected for AGVS,AS/RS and Carousel storage systems). ,	9Hrs
Unit IV Automated inspection & Group technology: Automated inspection methods -100% automated inspection, off-line & on -line inspection, distributed inspection & final inspection; coordinate. measuring Machine Construction, operation & benefits, Machine vision image acquisition & digitization, image processing & analysis, interpretation and applications; Group Technology: Part families, parts classification & coding, Opitz classification systems production. production. Flow analysis; Machine cell design -composite pat concept, types of cell design, benefits of group technology. ,	9Hrs

Unit V **Computer aided manufacturing** - Manufacturing planning, manufacturing control; Computer integrated manufacturing. **Flexible manufacturing systems** - Components, Types of systems, FMS layout configuration computer functions, data files, system reports, FMS benefits. **Computer aided process planning** - Retrieval CAPP systems, generative CAPP systems, benefits of CAPP. **Introduction to PLC Programming,** Types of PLC Languages, Ladder Diagram Format, Ladder Relay Instructions, Ladder Relay Programming ,	9Hrs

Sr. No.	List of Tutorials
01	Numerical's on Automated Flow lines
02	Line Balancing Problem (Largest Candidate Rule & RPW only)
03	APT Program on 3 different geometries
04	Numericals on AGVS,AS/RS and carousel storage System
05	Minimum Two tutorial in form of Quiz on Online platform like Moodle
06	Any other if required

References:

Text Books Recommended:

1. Automation, production System & CIMS Third edition (2007) M P, Groover PHI Prentice Hall
2 CAD/CAM Fifth edition (2008) Zimmers & Groover PIll Pearson Education India
3. Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press
4 Deb S.R., "Robotics", Tata McGraw Hill Publications, New Delhi.
5 Yoram Koren, ; Robotics for Engineers;, McGraw Hill Book Co.
6 John W Webb and Reis, Ronald A., "Programmable Logic Controllers: Principles & Applications",Prentice Hall.
6.Frank Petruzella," Programmable Logic Controllers", McGraw-Hill Education; 4 edition
7.K. Kundra, P.N. Rao, N.K.Tiwari "Numerical Control and Computer Aided Manufacturing" ,Tata McGraw Hill
8.Krar, S., and Gill "CNC Technology and Programming", , A., McGraw Hill publishers

Reference Books Recommended:

1. Numerical Control And Computer Aided Manufacturing 13th edition (2007)Rao, N K Tiwari, T K Kundra Tata McGraw-Hill Education
2 Computer Control of Manufacturing Systems 2005 Koren Mcgraw Hill

RTM Nagpur University-Mechanical Engineering
6th Semester
Automation In Production (BEME601P)
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
B.Tech 6th Sem Mechanical	**AUTOMATION IN PRODUCTION**	-	-	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Recognize automation, corroborating this knowledge with case studies on automation systems. study and analyze the material handling systems, robots and GT
CO2	Demonstrate NC programming (manual/apt)
CO3	Simulate program on CNC milling/ lathe
CO4	Work on CNC milling/ lathe

Sr. No.	**Automation In Production (BEME601P) Syllabus (Practical)**
01	Practice Programming on Manual Part Program
02	Simulation on CNC lathe (at least two Complex Geometric) {May be performed in group}
03	Simulation on CNC milling (at least two Complex Geometries) {May be performed in group}
04	Performance on CNC lathe (at least two Complex Geometric) {May be performed in group}
05	Performance on CNC milling (at least two Complex Geometries) {May be performed in group}
06	Performance/ Study Practical on Robot.
07	Part Coding and Group Technology
08	Study of FMS
09	Study of Automated inspection

Suggested References:

1. Automation, production System & CIMS Third edition (2007) M P, Groover PHI Prentice Hall

2..K. Kundra, P.N. Rao, N.K.Tiwari "Numerical Control and Computer Aided Manufacturing" ,Tata McGraw Hill

3. Deb S.R., "Robotics", Tata McGraw Hill Publications, New Delhi.

RTM Nagpur University-Mechanical Engineering
6th Semester
Energy Conversion-II (BEME602T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examina	Total	
B.Tech 6th Sem Mechanical	**Energy Conversion-II**	3	1	-	4	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1.	To give an overview of energy conversion system their type, applications, operation , testing methods
2.	To carry out thermodynamic analysis of various cycles of operation
3.	To gain basic knowledge of operation of IC Engine , gas turbine , jet propulsions, compressor , refrigeration and air conditioning system
4.	To Identify and understand the function of various components of IC Engine gas turbine , compressor, refrigeration and Air condition system.

Course Outcomes

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

CO1	Classify various types of I.C. Engines and explain the working of its various components and systems.
CO2	Analyze the effect of various operating variables on engine performance
CO3	Understand the working of Gas Turbine and Jet propulsion system
CO4	Analyze the vapour compression refrigeration system and psychometric process.
CO5	Understand the working of various types of compressors

Syllabus -Energy Conversion-II (Theory), 6th Semester , Mechanical Engineering	
Contents	**No of hours**
Unit I Internal Combustion Engines: Introduction, classification, components of I.C. Engines, working of two stroke and four stroke S.I. and C.I. Engines, valve and port timing diagram, Combustion in S. I. Engine, stages of combustion, ignition lag, detonation. Combustion in C. I. Engine, stages of combustion, delay period, diesel knock, abnormal combustion in S.I. and C.I. engines, detonation and knocking. Fuel injection in I. C. Engines: Fuel supply to S. I. Engine, carburetion, simple carburetor, components, operation, MPFI. Fuel supply to C. I. Engine, Fuel pump amd fuel injector,Modern Ignition System for S.I. Engines, Supercharging of SI and CI engines, Introduction to Electric and Hybrid Vehicles	08
Unit II Testing of I. C. Engines:- Performance parameters, measurement of indicated, friction & brake power, measurement of speed, fuel & air consumption, calculation of indicated & brake thermal efficiency, volumetric efficiency, relative efficiency and mechanical efficiency, percentage of excess air, Heat balance sheet, exhaust gas calorimeter, exhaust analysis, performance characteristics, factors influencing the performance of I.C. engines,	07
Unit III **Gas Turbines**:-Ideal cycles isentropic and small stage efficiency, application of gas turbine pressure losses, effect of intercooling, reheat & regeneration, fuel-air ratio, combustion efficiency, performance calculation, open cycle &closed cycle gas turbine plants cogenerations & combined power cycles , Axial Flow Turbines. **Jet Propulsion**: Simple turbojet cycle, Tuboprop, Ramjet & pulse jet, performance parameters like thrust power, propulsive power. Thermal efficiency, propulsive efficiency, overall efficiency, Chemical Rockets, types of propellants and their properties, cryogenic propellant, combustion phenomena, ignition and inhibitors. Basics of Electrical and Nuclear rockets	07
Unit IV **Refrigeration**: Introduction, definition & unit of refrigeration, COP ,single stage vapour compression refrigeration system, effect of subcooling and superheating on COP with P-h and T-S diagram, Vapor absorption refrigeration system (concept only), refrigerants, Ozone depletion. **Air conditioning**: Introduction, psychometric properties, psychometric processes such as heating cooling, humidification & dehumidification, Bypass factor, Split air conditioner, Inverter Air conditioner.	09

Unit V **Air Compressors**:- Introduction, classification, applications ,Positive displacement Compressors:- **Reciprocating compressors**: - Construction and working, isothermal, polytropic & adiabatic compression process, work done with and without clearance, P-V diagram, volumetric efficiency, effect of clearance, isothermal efficiency, methods for improving isothermal efficiency, mechanical efficiency. Multistage compression. **Rotary compressors**: Principle, operation, Roots blower , vane type , screw type , lobe type indicator diagram, work done, roots efficiency, vanes efficiency. **Centrifugal compressor**: - Principle, operation, parts, velocity diagrams, static & total head quantities, work done by impeller, isentropic efficiency, **Axial flow compressor**:- Principle, operation, parts, velocity diagrams, work done, degree of reaction, stage and polytropic efficiency.	10

List of Tutorials- Energy Conversion-II
1) Analysis of single stage reciprocating compressors.
2) Analysis of multistage reciprocating compressors.
3) Analysis of effect of undercooling and superheating on COP of VCR system.
4) Performance analysis of centrifugal compressor.
5) Performance analysis of axial flow compressor.
6) Numerical on Morse test.
7) Analysis of multi-cylinder engines.
8) Numerical on heat balance sheet.
9) Analysis of gas turbine cycle.
10) Analysis of Jet propulsion system.
11) Analysis of Air Conditioning systems.

References- Energy Conversion-II

Text Books Recommended:

1. Basic and Applied Thermodynamics, P.K. Nag, TMH publication
2. Thermal Engineering, R. K. Rajput, Laxmi publications.
3. Refrigeration and Air Conditioning, Arora and Domkundwar, Dhanpat Rai and Sons.
4. Gas Turbine& Jet Propulsion, Dubey & Khajuriya, Dhanpat Rai & Sons
5. Internal Combustion Engine –V Ganesan , Tata McGraw Hill

Reference Books Recommended:

1.Thermal Engineering, Mathur & Mehtra, Jain Brothers Publications, New Delhi
2. Refrigeration & Air conditioning, Stocker & Jones, McGraw Hill Publication.
3.Elements of Gas Turbine Propulsion, Jack D. Mattingly McGraw-Hill, Inc., 1996.
4. Internal combustion engine fundamentals, by: John Heywood, pub.: McGraw- Hill .
5. N.A.Cumpsty, Jet Propulsion, Cambridge University Press, 2000

RTM Nagpur University-Mechanical Engineering
6th Semester
Energy Conversion-II (BEME602P)
Syllabus (Practical)

Semester	Course Title	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Evaluation	University Examination	Total
B.Tech 6th Sem Mechanical	**Energy Conversion-II Lab**	0	0	2	1	25	25	50

Sr. No.	Course Objective The objective of this course is–
1.	To provide knowledge of how energy can be converted from one form to another.
2.	Students will observe the loss in useful energy as a result of such a conversion and measure the efficiency for such conversions.
3.	To make students familiar with the design and operating characteristics of engines. ¬
4.	To understand the basic concept of refrigeration and air conditioning.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Identify** different components of IC engine, type of compressor , VCR system
CO2	**Demonstrate** and **Determine** performance of I,C, engine ,compressor and VCR system
CO3	**Construct** Heat balance sheet for single/multi cylinder CI and SI engine.
CO4	**Apply** Mores Test on Multi cylinder S.I. Engine
CO5	**Analyze** the thermodynamic performance of Gas turbine
CO6	Develop an ability to optimize future engine designs for specific sets of constraints (fuel economy, performance, emissions)

Sr. No.	List of Practical
01	Performance testing of two stroke / Four stroke Multi cylinder Diesel and Petrol engine
02	Performance testing of variable compression ratio engine
03	Morse test on Multi cylinder Diesel/ Petrol engine
04	Creating heat Balance Sheet for Diesel Engine and petrol engine
05	Demonstration of fuel injection systems and ignition systems of I. C. Engines.
06	Valve Timing diagram for petrol engine
07	Performance testing of multi stage Reciprocating compressor
08	Performance testing of Centrifugal and Axial flow Compressor
09	To study open cycle constant pressure combustion gas turbine with inter cooler, regenerator and reheater.
10	Demonstration to study Psychometric Processes on mini-air conditioning tutor.
11	Performance testing of vapour compression refrigeration system
12	Performance testing of vapour absorption refrigeration system.

References- Energy Conversion-II

Text Books Recommended:

1. Basic and Applied Thermodynamics, P.K. Nag, TMH publication
2. Thermal Engineering, R. K. Rajput, Laxmi publications.
3. Refrigeration and Air Conditioning, Arora and Domkundwar, Dhanpat Rai and Sons.
4. Gas Turbine& Jet Propulsion, Dubey & Khajuriya, Dhanpat Rai & Sons
5. Internal Combustion Engine –V Ganesan , Tata McGraw Hill

Reference Books Recommended:

1.Thermal Engineering, Mathur & Mehtra, Jain Brothers Publications, New Delhi
2. Refrigeration & Air conditioning, Stocker & Jones, McGraw Hill Publication.
3.Elements of Gas Turbine Propulsion, Jack D. Mattingly McGraw-Hill, Inc., 1996.
4. Internal combustion engine fundamentals, by: John Heywood, pub.: McGraw- Hill .
5. N.A.Cumpsty, Jet Propulsion, Cambridge University Press, 2000

RTM Nagpur University- Mechanical Engineering
6th Semester
Dynamics of Machines –(BEME603T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examinatio	Total	
B.Tech 6th Sem Mechanical	**Dynamics of Machines**	3	1	-	04	30	70	100	3

Sr. No.	Course Objective The objective of this course is
1.	Make students understand the concepts of dynamics of the machines, effect of dynamic forces involved in various machine components, unbalances in the system due to these forces causing vibration and vibration control techniques.
2	To introduce them with the dynamics of rotating and energy absorbing components like gyroscopes, dynamometers, brakes and flywheels
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Comprehend the machine dynamics through basic principles to interpret their application and examine near to life problems due gyroscopic effects and determine the conditions for stability of ships, airplanes and automobile.
CO2	Analyze dynamic force conditions in planer linkages and cams to determine required driving torque condition (graphically/ analytically).
CO3	Estimate the unbalanced forces due to rotating and reciprocating masses in a mechanical system and calculate (graphically/ analytically) the balancing masses required for safe/ smooth operation of these mechanical systems.
CO4	Identify the requirement of flywheel, brakes, and dynamometers in a mechanical system and calculate inertia of flywheel and braking condition to be incorporated in engines and machines.
CO5	Recognize and interpret the concept of vibration in various mechanical systems and distinguish vibration characteristics for 1 & 2 DOF systems to evaluate the conditions for its control/ use.

Syllabus- Dynamics of Machines(Theory,) 6th Semester , Mechanical Engineering	
Contents	No of hours
Unit I – Gyroscopic Effect: Introduction, precession motion, Effect of gyroscopic couple on shaft bearings, airplane, naval ship, vehicle stability. Introduction to electronic gyroscopes and its applications in the modern automobiles.	9
Unit II - Dynamic force analysis: Concepts in machine element dynamics. D'Alembert principle. Application of these approaches for equilibrium of mechanisms, Static and Dynamic force analysis of planar linkages such as four bar chain and reciprocating mechanism by graphical method, Analytical method. Cam dynamics and jump-off phenomenon.	9
Unit III - Balancing **Balancing of rotating masses:** in one and several planes, static and dynamic balancing machines. [Graphical and analytical treatment] **Balancing of reciprocating masses:** in single and multi-cylinder engines, inline, radial and V type. Primary and secondary balancing analysis. Concept of direct and reverse crank. [Graphical and analytical treatment]	9
Unit IV- Brakes and Dynamometer – Types of brakes, block brake, band brake, internal expanding brake and effect of braking on vehicle, types of dynamometer, absorption and transmission dynamometer, chassis dynamometer, eddy current dynamometer. [Analytical treatment for Brakes] **Flywheel** - Turning moment Vs crank angle diagram for single- cylinder and multiple-cylinder engines, flywheel application in punching machines. [Analytical treatment]	9
Unit V - Vibration Analysis: Types of vibration, degree of freedom, method of vibration analysis of un-damped and damped free & forced vibration system. Types of damping, Logarithmic decrement, magnification factor, vibration isolation and transmissibility. Whirling of shaft and critical speed of rotors. Torsional oscillation of two-disc and three disc rotors, torsional vibration of a geared system.	9

Sr. No.	List of Tutorials - Dynamics of Machines, 6th Semester , Mechanical Engineering
01	Problems on airplanes, ships and other vehicles stabilization
02	Problems on cam dynamics
03	Problems on static and dynamic balancing of rotating masses
04	Problems on firing order in multi cylinder and its effect on balancing of engines
05	Problems on different types of brakes and flywheels
06	Problems on free, damped and undamped vibrations. One problem each on forced vibrations and torsional vibrations.

Assignments (Optional-To be decided by individual faculty):

1. Preparations of computer algorithm using analytical method for dynamic force analysis using MS excel spread sheets.
2. Study and analysis of brakes used in various Motorcycle models available in Indian market at least four models of equal engine cc.
3. Study and analysis of shock absorbers used in various Motorcycle models available in Indian market at least four models of equal engine cc.

References:

Text Books Recommended:

1. Theory of Machines, Rattan S. S, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Mechanism & Machine Theory, A.G. Ambekar, PHI Publication.
4. Mechanical Vibrations, V. P. Singh, Dhanpatrai & Co.

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Reference Books Recommended:

1. Theory of Mechanisms and Machines, Ghosh A. and Mallick A.K., Affiliated EastWest Press Pvt. Ltd., New Delhi, 1988.
2. Theory of Machines and Mechanisms, Shigley J.E. and Uicker J.J.,McGraw-Hill, Inc., 1995.
3. Mechanism and Machine Theory, Rao J.S. and Dukkipati R.V., Wiley-Eastern Limited, New Delhi, 1992
4. “Theory of Machines, Sadhu Singh, Pearson Education.
5. “Mechanical Vibrations”, S. S. Rao, Addison-Wesley Longman

RTM Nagpur University- Mechanical Engineering
6th Semester
Dynamics of Machines –(BEME603P)
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
						Continual Assessment	University Examination	Total
		L	T	P				
B.Tech 6th Sem Mechanical	Dynamics of Machine	-	-	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Demonstrate the concept of gyroscopic effect through the working model.
CO2	Analyze the performance of mechanisms and Perform dynamic force analysis of linkages and cams.
CO3	Demonstrate record and interpret data of vibration characteristics of mechanical vibratory systems.
CO4	Perform analysis of brakes, dynamometers and flywheels.
CO5	Identify the importance of safety, team work and effective communication for conduction of activity.

	Syllabus- Dynamics of Machines (Practical) 6th Semester , Mechanical Engineering
Sr. No.	**List of Practical (Have to perform at least eight practical's)**
01	Dynamic balancing of rotating masses (study of wheel balancing machine along with performance by visiting any automobile workshop).
02	Determination of jump speed of a cam follower mechanism
03	Critical speed of shafts.
04	Performance characteristics of Gyroscope.
05	Determination of natural frequency of Free longitudinal vibration of single DOF system
06	Torsional vibration of single and two rotor system.
07	Dynamic force analysis of four bar mechanisms OR Dynamic force analysis of slider crank mechanism.
08	Performance analysis of quick return motion mechanism in a machine tool in college workshop
09	Performance on flywheel of an engine in IC engine laboratory.
10	Performance of dynamometer in IC engine lab
11	Determination of braking efficiency of two wheeled vehicle

References:

Text Books Recommended:

1. Theory of Machines, Rattan S. S, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Mechanism & Machine Theory, A.G. Ambekar, PHI Publication.
4. Mechanical Vibrations, V. P. Singh, Dhanpatrai & Co.

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Reference Books Recommended:

1. Theory of Mechanisms and Machines, Ghosh A. and Mallick A.K., Affiliated EastWest Press Pvt. Ltd., New Delhi, 1988.
2. Theory of Machines and Mechanisms, Shigley J.E. and Uicker J.J.,McGraw-Hill, Inc., 1995.
3. Mechanism and Machine Theory, Rao J.S. and Dukkipati R.V., Wiley-Eastern Limited, New Delhi, 1992
4. "Theory of Machines, Sadhu Singh, Pearson Education.
5. "Mechanical Vibrations", S. S. Rao, Addison-Wesley Longman

RTM Nagpur University-Mechanical Engineering
6th Semester (Elective- I)
Mechanical Vibrations-(BEME604T)
Syllabus

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assess	University Exam	Total	
B.Tech 6th Sem Mechanical	Elective -I Mechanical Vibrations	3	1	0	4	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To understand and analyse vibrations in various mechanical systems and using mathematical treatment design vibration isolators and methods of vibration reduction.
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Establish mathematical model and determine natural frequencies of single and two DOF systems
CO2	Apply different methods to design vibration absorbers.
CO3	Understand vibrations in multi degree of freedom system and able to prepare vibration models
CO4	Analyse vibrations in continuous systems
CO5	Use finite element method in vibration analysis.
CO6	To measure and analyse vibrations using vibration monitoring devices

Syllabus- Mechanical Vibrations, 6th Semester , Mechanical Engineering	
Contents	No of hours
Unit I - Free & forced vibration, undamped and damped single degree of freedom systems subjected to harmonic and other periodic excitations. Convolution integral and response to arbitary excitation. Vibration isolation and transmissibility. Solution using laplace transforms, Runga kutta method, structured damping, estimation of natural frequency for single and two degree of freedom.	8
Unit II- Energy method applied to multi degree freedom system. Lagranges equation. Transient response of one degree-of-freedom systems. Generalized formulation of mass, damping and stiffness matrix and its numerical solutions. Vibration absorber, Influence Coefficients and flexibility matrix of bending vibration of beam and multi-disc rotor. Mode shapes and orthogonality principle, Steady-state response to harmonic excitation.	8
Unit III – Numerical techniques for Multi degree of freedom systems. Matrix iteration method. Holzer's method for torsional vibration. Dunkeleys method for critical speed determination of multi disc rotor. Rayleigh Ritz, Stodola method for determination of all the natural frequencies and mode shapes. Modal matrix and expansion theorem. Free and forced response by modal analysis.	8
Unit IV - Vibration of continuous system, Vibration of elastic bars. Axial vibration of rod, bending vibration of beam and torsional vibration of shaft. Hamiltons principle and derivation of equation of motion, Rayleigh quotient. Modal co-ordinates and modal forces. Free and forced response through modal analysis. Introduction to Finite Element Method in vibration of continuous system.	8
Unit V - Vibration pickup, seismometers, accelerometer, proximity probe spectrum analyzer, FFT & DFT (DiscreteFT), vibration measurement, digital vibration measurement, philosophy of vibration condition monitoring	6

Sr. No.	List of Tutorials
01	Problems on determination of natural frequency of 2 DOF system and transmissibility
02	Problems on design of vibration isolators
03	Problems on determination of critical speeds
04	Problems on response through modal analysis
05	Problems mode shape computation for simple rod and beam problem.

References:

Text Books:

1. Mechanical Vibration, V. P. Singh, Dhanpatrai & Co.
2. Mechanical Vibrations, J. S. Rao, New Age publishers.
3. Mechanical Vibration, Shrikant Bhave, Pearson publications.
4. Theory of Vibration, W.T. Thomson, CBS.
5. Mechanical Vibration, Debabrata Nag, Wiley.

Reference Books Recommended:

1.Mechanical Vibrations, S.S. Rao, Pearson.
2. Advanced Theory of Vibration, J.S. Rao, New Age International.
3. Vibration Condition Monitoring of Machines, J. S. Rao, Narosa publications.
4. Random Vibration in Mechanical Systems, Crandall & Mark, Academic press.
5. Mechanical Vibration, William J.Palm, John Wiley.

RTM Nagpur University- Mechanical Engineering
6th Semester-Elective-I
Synthesis of Mechanisms –(BEME604T)
Syllabus

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	Univ Exam	Total	
B.Tech 6th Sem Mechanical	**Elective -I Synthesis of Mechanisms**	3	1	-	04	30	70	100	3

Sr. No.	Course Objective The objective of this course is
1	To enrich the students with different methods of contriving the mechanisms depending on the needs of input output motion, positions of points and the applications by applying their intuition.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Critically analyze the existing machines and mechanisms
CO2	Synthesize mechanisms quickly using graphical technique
CO3	Synthesize mechanisms using analytical technique and prepare computer algorithms.
CO4	Synthesize mechanisms using coupler curves as per the motion requirement
CO5	Understand spatial mechanisms and apply it for design of robotic manipulators

Syllabus- Synthesis of Mechanisms (Elective I), 6th Semester , Mechanical Engineering	
Contents	No of hours
Unit I – Introduction Types of mechanism, kinematics synthesis, science of relative motion, tasks of kinematic synthesis. Function generation, Path generation & Motion generation problem with practical applications. Concept of Transmission angle, limiting conditions, toggle position, circuit and branches in linkages. Degree of Freedom, Class-I, Class-II Chain. Harding's notations, Grashof criterion, Grubler's criterion, .	9
Unit II – Graphical Synthesis Co-ordination of input-output link motion, relative pole technique, inversion technique, overlay technique, graphical synthesis of Quick-Return Mechanism for optimum transmission angle. Introduction to path generation problem , synthesis for path generation, with & without prescribed timing using graphical method, Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebesychev spacing, types of errors,	9
Unit III – Analytical synthesis Synthesis of four-bar mechanisms. Freudenstein's equation, synthesis for three, four and five accuracy points. Introduction to computer aided analysis and design of mechanism using computer programming.	9
Unit IV – Coupler curves Equations of coupler curve, Robert-Chebychev theorem, double points and symmetry.	9
Unit V - Spatial Mechanisms and Robotics Introduction, mobility, describing spatial motions, Kinematic analysis and synthesis of spatial mechanisms, Kinematics of robotic manipulators	9

Tutorials: Based on above syllabus units

References:

Text Books Recommended:

1. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, McGraw-Hill.
2. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L.Norton, Tata McGraw Hill.

Reference Books Recommended:

1. Advanced Mechanism Design–Analysis and Synthesis - Vol. I and II, A.G.Erdman and G.N. Sandor, Prentice – Hall.
2. Kinematics and Mechanism Design, C.H. Suh and C.W. Radcliffe, John Wiley & Sons.
3. Kinematics and Linkage Design, Hall, A.S., Balt Publishers.
4. Kinematic Synthesis of Linkages, R.S. Hartenberg and J. Denavit, McGraw Hill.
5. Kinematics and Dynamics of Machinery, R L Norton, McGraw Hill.
6. Mechanism synthesis and analysis, A. H. Soni, McGraw Hill

RTM Nagpur University-Mechanical Engineering
6th Sem-(Elective-I)
Operation Research(BEME604T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech . 6th Sem Mechanical	**Operation Research (Elective-I)**	03	0	0	03	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	To study the various OR tools,
2	Study to apply appropriate model to the given situation.
3	Formulate the problem.
4	Solve and analyze the problem

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry
CO2	convert given situation to mathematical form and determine optimal settings.
CO3	understand Operations Research models and apply them to real-life problems;
CO4	manage projects for minimum total cost and smooth level of resources.
CO5	make decisions related to age of replacement of equipment
CO6	develop simulation of real life system to analyze and optimize system concerned.

Syllabus -Operation Research(BEME604T)-6th Sem-(Elective-I)	
Contents	No of hours
Unit I Introduction to OR & Basic OR Models, Definition Characteristics and limitations of OR.Linear programming: Introduction, Linear programming formulation, solutions of LPP by graphical methods and simplex method. formulation of Dual of LPP. ,	08 Hrs
Unit II Formulation of transportation model, Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's Approximation Method) Optimality Methods, Unbalanced transportation problem, Variants in Transportation Problems. Formulation of the Assignment problem, unbalanced assignment problem, typical assignment & travelling salesman problem ,	08 Hrs
Unit III Replacement Models- Concept of equivalence, Interest Rate, Present worth, economic evaluations of Alternatives, Group replacement models. Inventory Control Models- Introduction and inventory management concepts, Economic Order Quantity model (EOQ), Economic Production Quantity model (EPQ), model for purchase allowing for shortages,ABC analysis.	08 Hrs
Unit IV Drawing of Network, CPM & PERT, probability of completion of project, Cost Analysis of Project, and Concept of Crashing. Allocation & updating of Network. ,	08 Hrs
Unit V Sequencing Model – Introduction, Sequencing Model: n job two machines problem, n job 3 machines problem, 2 jobs m machine problem. Simulations –Concept, applications in waiting line situations, inventory and network. Queuing models – Poisson arrivals and Exponential service times – Single channel models (MM1)and Multi channel models. (No derivation expected) ,	08Hrs

References:

Text Books Recommended:

1. 1. Operation Research, Heera & Gupta, S Chand Publications
2. Operation Research, JK Sharma, Mc Millian Publications

Reference Books Recommended:

1. Operation Research, Hamdy Taha, Prentice Hall
2. Operation Research, Liberman, McGraw Hill Publications
3. Operation Research , S D Sharma, Kedarnath Ramnath & Co.
4. Operations Research , Pannerselvam: Prentice Hall of India 2010

RTM Nagpur University-Mechanical Engineering
6th Sem- (Elective-I)
Production Planning and Control-(BEME604T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
						Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	Production Planning and Control (Elective-I)	L	T	P					
		3	0	0	3	30	70	100	3 hrs

Sr. No.	Course Objective The objective of this course is–
1	Understand need of various functions in production planning and control for better management of manufacturing and/or service systems.
2	Use qualitative and quantitative forecasting techniques for short, medium, and long range forecasting.
3	Develop material requirements plans (MRP) as part of resource requirements planning systems.
4	Develop capacity requirements plans as part of resource requirements planning systems.
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand need of various functions in production planning and control for better management of manufacturing and/or service systems.
CO2	Use qualitative and quantitative forecasting techniques for short, medium, and long range forecasting.
CO3	Develop material requirements plans (MRP) as part of resource requirements planning systems.
CO4	Use heuristic decision rules to make lot-sizing decisions.
CO5	Develop capacity requirements plans as part of resource requirements planning systems.
CO6	Develop quantitative models to manage independent demand inventory systems.

SYLLABUS -Production Planning and Control -(Elective-I)-6TH Sem	
Contents	No of hours
Unit I Production Planning : Introduction, Production Planning and Production Control, Functions and Objectives of PPC, Production procedure, Information requirement of PPC, Manufacturing Methods and PPC, Product Life Cycle, Product design.	8
Unit II Demand Forecasting : Forecasting and Prediction, Long-term and short-term forecasting, Time series analysis, least square method, exponential smoothing method, Moving Average forecasting.	7
Unit III Capacity And Process Planning : Introduction, Measurement and measures of capacity, factors influencing effective capacity, factors favouring over capacity and under capacity, aggregate planning, linear programming approach to aggregate planning, Master Production Schedule,Process Planning –Machine, Manpower Planning, line balancing. ,	8
Unit IV Inventory Control : Introduction, Types of inventories, reasons for keeping inventories, inventory control, benefits of inventory control, cost associated with inventory, inventory cost relationships, safety stock, inventory models, deterministic models. Material Requirement planning (MRP) **:** Stochastic models, inventory control system. Introduction, Objectives of MRP, MRP-I System, MRP-II system, Lot sizing consideration	8
Unit V Production Control : Introduction, loading, sequencing, priority sequencing, scheduling, dispatching and progressing.	7

Sr. No.	List of Tutorials
01	Tutorial on production processes, manufacturing method, product life cycle
02	Long term and short term for casting, time series analysis
03	Measurements and measures of capacity
04	Inventory control, types of inventory
05	MRP1 AND MRP2
06	Loading, sequencing, dispatching

References:

Text Books Recommended:

1. Martand Telsang, “Industrial Engineering and Production Management”, S. Chand, New Delhi (2009)

2.Buffa, “Modern Production operations Management”, Wiley Eastern, New York (1999)

3. Panneer Selvan R, “Production and Operations Management”, Prentice Hall India, New Delhi (2002)

RTM Nagpur University-Mechanical Engineering
6th Sem (Elective- 1)
Convective Heat Transfer-(BEME604T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	**Elective- 1 Convective Heat Transfer**	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	Learn the various aspects of convective heat transfer and laws associated with it
2	Apply their knowledge of basic heat transfer for a detailed analysis of forced and free convection
3	Solve real-life problems related to heat transfer.
4	Design of heat transfer equipment for industrial application
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Explain the fundamental and advanced principles of forced and natural convection heat transfer processes.
CO2	Apply the principles of natural convective to estimate the heat dissipation from external flow devices.
CO3	Solve the problem of internal flow natural convection.
CO4	Relate to the current challenges and opportunities in the field of turbulent convective heat transfer.
CO5	Formulate and solve problems related to external wall flows and convection heat transfer.

SYLLABUS- Convective Heat Transfer	
Contents	No of hours
Unit I : Fundamental equations, Dimensionless numbers, Flows with variable physical properties: heat transfer in a laminar Couette, Flows with dissipation, cooling of a sphere by a gas flow. Laminar Fully Developed Forced Convection in Ducts: Hydrodynamics, Heat transfer in a parallel-plate channel with uniform wall heat, Flow in a plane channel insulated on one side and heated at the uniform temperature on the opposite side. Protection of a wall by a film of insulating material, cooling of a moving sheet.	10
Unit II : External Natural Convection: Introduction, Boussinesq model, Dimensionless numbers Scale analysis, Natural convection near a vertical wall, Integral method for natural convection, Correlations for external natural convection, Mixed convection.	9
Unit III : Internal Natural Convection: Introduction, Scale analysis, fully developed regime in a vertical duct heated at constant temperature, Enclosure with vertical walls heated at constant temperature.	9
Unit IV : Turbulent Convection: **Internal Wall Flows**: Introduction, Hydrodynamic stability and origin of the turbulence, Reynolds averaged Navier-Stokes equations, Wall turbulence scaling, Eddy viscosity-based one point closures, Empirical correlations, Exact relations for a fully developed turbulent channel flow	9
Unit V Turbulent Convection: External Wall Flows: Introduction, Transition to turbulence in a flat plate boundary layer Equations governing turbulent boundary layers, Scales in a turbulent boundary layer Velocity and temperature distributions, Integral equations, Analogies Integral formulation of boundary layers over an isothermal flat plate.	8

References:

Text Books Recommended:

1. Convective Heat Transfer: Solved problems by Michel Favre-Marinet and Sedat Tardu; John Wiley & Sons, Inc.
2. Convective Heat and Mass Transfer by W. M. Kays and M. E. Crawford; McGraw Hill.
3. Convective Heat Transfer by Adrian Bejan; John Wiley and Sons.

.

Reference Books Recommended:

1. Introduction to Convective Heat Transfer Analysis by Patrick H. Oosthuizen and David Naylor.
2. Yunus A. Cengel, Heat Transfer A Practical Approach – Tata McGraw Hill - Second Edition 2014.
3. Frank P. Incropera and David P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons, Seventh Edition, 2011.

RTM Nagpur University-Mechanical Engineering
6th Sem (Elective- 1)
Power Plant Engineering-(BEME604T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assess	University Exam	Total	
B.Tech 6th Sem Mechanical	**Power Plant Engineering (Elective I)**	3	-	0	03	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To study the basics of power generation systems for different types of power plants(Conventional and Non-Conventional)
2	To estimate the performance of the plants based on cost /KW generation, maintenance etc
3	To study the combined operation of different power plants.
4	To study the environmental impact for all types of power generation

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Student will able to understand the components, fuel and its associated terminologies and complete working of steam power plant .Also will be able to learn about advantages, drawbacks and environmental impact .
CO2	Students will get acquainted with working of Gas Turbine power plant and Diesel electric power plant, their comparison with other power plants and also Introduce to captive power plant.
CO3	Student will be able to understand the complete working of hydroelectric power plant ,its advantages and comparison with other power plants.
CO4	Student will be able to understand the importance of Nuclear power generation in India, working of various nuclear reactors and complete working of nuclear power plant, waste disposal and its impact on environment and also its comparison with other power plants.
CO5	Student will be able to understand the concept of combined power plant and gets acquainted with the emerging power generation technologies. Also will able to undertake the power load analysis and economic analysis of power generation system.

SYLLABUS - Power Plant Engineering	
Contents	No of hours
Unit I Steam power plant: Introduction to steam power plant and power plant layout, components, functions, plant efficiencies. Fuel and its characteristics, handling, storage, preparation and firing methods. Ash and dust collection and handling. Steam Generators: Classification, construction and working Details of different accessories like air pre heaters ,economizers, super heaters, details of various systems like draught system, feed water treatment system ,condensers, cooling tower and its classification, electrostatic precipitator, fabric filter and bag houses, advantages , disadvantages ,waste disposal, Effect on Environment .	10
Unit II Gas Turbine power plant : Introduction, power plant layouts, open cycle, closed cycle power plants, various components and systems, methods to improve efficiency—intercooling, reheating and regeneration and their combination. Diesel electric power plant: introduction, layout, type of diesel engines, different components and systems, super charging of diesel engine, performance, comparison with other power plants. Introduction to captive power plant. ,	09
Unit III Hydroelectric power plant: Hydrology: - Rainfall runoff, hydrograph, flow duration curve, mass curve. Site selection, classification of hydroelectric power plant, layout, details of different components, selection of prime movers, governing of hydro turbine, advantages and comparison with other power plants. ,	09
Unit IV Nuclear Power Plant:- Introduction to nuclear Engineering, Global scenario, Need of nuclear power in developing countries like India ,terminologies like atomic nuclei, atomic number ,mass number ,binding energy and energy release, types of nuclear reaction and its initiation, fission, fission chain reaction, components of nuclear reactors and its material. Nuclear reactor and its classification in detail. Site selection for location of nuclear power station, present & proposed nuclear plants in India, Nuclear waste disposal and its effect on environment, comparison with other power plants.	09

Unit V Combined operation of different power plants : Binary cycle, Combined operation of different plants and their analysis ,advantages, Cogeneration, Trigeneration Emerging Technologies: MHD power generation, Fuel cell, Solar thermal power plant, Photovoltaic power generation, Geothermal power plant, Wind power plant, Tidal power plant Economics of Power Generation: Load curves, different terms and definitions, peak load, effect of fluctuating loads on power plant design and operation. , ,	09

Sr. No.	List of Tutorials
01	Basic component of steam power plant and modified steam power cycle
02	Steam generators and their component
03	Layout of hydro power plant and site selection
04	Nuclear reactor and nuclear waste disposal
05	Combined power plant and their advantages
06	Economics of power plant and different terms associated with it

References:

Text Books Recommended:

1. Power Plant Engineering, P. K. Nag, Tata McGraw Hill publication.
2. Power Plant Engineering, Domkundwar, Dhanpat Rai & Sons.
3. P. C. Sharma, Power Plant Engineering, Pub S. K. Kataria & Sons
4. Rajput R.K., *A Textbook of Power Plant Engineering*, Laxmi Publication

.

Reference Books Recommended:

1. Power Plant Technology, M. M. EI-Wakil, McGraw Hill publication
2. Power Plant Engineering, S.Gautam, Vikas Publication Pvt. Ltd

RTM Nagpur University- Mechanical Engineering
6th Semester-Elective-II
Tribology –(BEME605T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	Elective-II **Tribology**	3	1	--	4	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	Students should understand the concepts of friction, wear and the methods of avoiding them through proper lubrication and bearing design.

Course Outcomes

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

CO1	Select materials and lubricants to suggest a tribological solution to a particular situation.
CO2	Understand the concept of thermal equilibrium and heat balance
CO3	Apply the basic knowledge to design simple journal bearings
CO4	Design thrust and step bearings
CO5	Design and selection of antifriction bearings
CO6	Understand friction and effects as wear, wear mechanisms, wear resistant materials

Syllabus- **Tribology**, (Elective II) , **6th Semester , Mechanical Engineering**	
Contents	No of hours
Unit I - Lubrication: Introduction, properties and testing of lubricants, viscosity, effect of temperature and pressure on viscosity, basic equations, generalized Reynold's equation, energy equation of state. Wear: wear of metals, classification of wear, mechanisms of wear, quantitative laws of wear, wear resistant materials. . Friction: Friction of metals, friction theories, surface contaminants, frictional heating.	9
Unit II- Idealized hydrodynamic bearings, plane slider bearings, slider bearing with pivoted shoes, step bearings, idealized journal bearings, finite bearings, electrical analogy method, analytical solution, numerical solutions, oil flow and thermal equilibrium, circumferential and axial flow, heat balance.	9
Unit III – Bearing design, practical considerations, design of journal bearings, squeeze film bearings, parallel surface bearing, step bearings, hydrodynamic instability, stiffness and damping coefficients, stability.	9
Unit IV - Externally pressurized oil bearings, circular step bearings, rectangular thrust bearings, opposed pad bearings, multi races bearings, gas lubricated bearings, governing equations, infinitely long plane slider bearings, infinitely long journal bearings, finite journal bearings, externally pressurized gas bearings, porous gas bearings, elasto-hydrodynamic lubrication, dimensionless parameters, film thickness equations.	9
Unit V – Ball bearings, deep groove radial bearings, angular contact bearings, thrust ball bearings, surface roughness on hydrodynamic bearings and elasto-hydrodynamic line contacts, derivation of average Reynolds equation for partially lubricated surface, effect of surface roughness on journal bearings.	9

LIST OF TUTORIALS: Tutorials based on above syllabus.

References:

Text Books:

1. Principles in Tribology, Edited by J. Halling, 1975
2. Hydrostatic Lubrication, Bassani R. and Piccigallo B., Elsevier Publication.
3. Bernard J. Hamrock, "Fundamentals of Fluid Film Lubrication", McGraw Hill Publication
4. Tribology in Machine Design, Stolarski T.A., Butterworth Heinemann, Oxford

Reference Books Recommended:

1. S.K. Basu, B. B. Ahuja, S. N. Sengupta , "Fundamentals of Tribology", EEE, PHI Pvt. Publications Ltd.
2. A. Cameron, "Basic Lubrication Theory", Ellis Horwood Ltd, 1981.
3. Friction and Lubrication of Solids, Bowden F.P. and Tobor D., Clarendon Press, Oxford.
4. An Introductory Guide to Industrial Tribology, Denis Summers, Smith J., Mechanical Engineering Publication, London.
5. Handbook of Tribology, Bharat Bhushan & Gupta B.K., McGraw Hill.

RTM Nagpur University- Mechanical Engineering
6th Semester-Elective-II
Tool Design –(BEME605T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	Tool Design (Elective-II)	3	-	--	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To impart knowledge of design and selection of tools used various manufacturing processes like single point cutting tools, multipoint cutting tool, press working cutting operation die-punch, press working forming operation die-punch, forgings process tools, jigs and fixtures.

Course Outcomes	
After the successful completion of this course the students are able to:	
CO1	Design single point and multi-point cutting tools.
CO2	Design various press working cutting operation dies for given sheet metal parts, also will be able to suggest heat treatment cycle for these dies.
CO3	Understand terminologies and design considerations related to press working bending, forming and drawing dies.
CO4	Explain and classify various forging dies and design machine forging dies.
CO5	Design simple blow and injection molds for plastic parts.

Syllabus - Tool Design (Elective II), 6th Sem, Mechanical Engineering	
Contents	No of hours
Unit-I:Design of single point and multi-point cutting tools **Design of single Point Cutting Tool:** Form tools- Introduction, Types, design of form tools. **Design of multipoint cutting tools:** Drills- Introduction, Types, Geometry, Design of drill, Milling cutters - Introduction, Types, Geometry, and Design of milling cutters.	**[9 Hrs.]**
Unit-II: Design of Press working Cutting operation dies **Press working (Cutting operation dies):** Introduction, Press working operations, construction and working of metal cutting dies e.g. simple die, compound die, progressive die, combination die. Design of heat treatment cycle for press tools Principle of metal cutting, press tonnage capacity, cutting forces, method of reducing cutting forces. **Blanking & Piercing die design –** Simple, compound & progressive dies.	**[9 Hrs.]**
Unit-III: Design of Press working forming operation dies **Bending:** Bending terminology, types of bending operation, blank development, spring back and its prevention, bending force and design of bending dies. Forming: Introduction, types of forming dies - Solid form dies, pad type form dies, curling dies, embossing dies, coining dies and its design. **Drawing:** Metal flow in drawing operation, factors affecting metal flow, calculation of number of draws, development of blank, drawing force, blank holding force and design of various types of drawing dies i.e. single action draw die, double action draw die and inverted dies.	**[9 Hrs.]**
Unit-IV: Forging die design and Design of molds : Introduction, Classification of forging dies, Single impression dies, Multiple Impression dies and Forging design factors. Preliminary forging operation - fullering, edging, bending, drawing, flattering, blacking finishing, cutoff. Die design for machine forging in closed & open die forging, materials of forging dies . **Mould Design:** Design of Simple Blow Moulds for Articles such as bottles, cans Design of simple two plate injection moulds , Mould Materials.	**[9 Hrs.]**
Unit-V: Design of Jigs and Fixtures: Introduction, general principles for design of jigs and fixtures, principle of location, principle for clamping, clamping devices, types of jig bushes, material and heat treatment, design of drill jig. Design of Milling Fixtures and lathe fixtures.	**[9 Hrs.]**

References:

Text Books Recommended:

1. Production Engineering ,P.C. Sharma, S. Chand Publication
2. Tool Design, Donaldson, Tata McGraw Hill, New Delhi
3. Jigs and Fixtures, P.H.Joshi, Tata McGraw Hill, New Delhi.

Reference Books Recommended:

1. Fundamentals of the Tool Design, ASTME, Prentice-Hall of India Private Ltd., New Delhi.
2. Manual of Jigs and Fixtures Design, Henrickson, Industrial Press Inc., New York.

RTM Nagpur University- Mechanical Engineering
6TH SEM-(Elective II)
Advanced Manufacturing Techniques-BEME605T
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	Advanced Manufacturing Techniques (Elective II)	3	0	0	03	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	This course is designed to provide students with an overview of a wide variety of non-traditional machining processes for processing of engineering materials.
2	It will help students to learn principles, operations, capabilities, process parameters, economics and application of various non-traditional machining processes, various unconventional welding techniques.
3	It will help students to learn and understand the importance of non-traditional machining processes and unconventional welding techniques.
4	In all to generate interest in learning and develop the ability in students to select and apply suitable processes for an engineering product.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand and compare the different Non-Traditional machining process with their need, economics and application as well as historical development. Understand the basics of High speed grinding, Hot and Cold machining.
CO2	Understand the basics of Abrasive Jet Machining (AJM), Ultrasonic Machining process and Water Jet Machining.
CO3	Get acquainted with the Electro-Chemical Machining, Electrochemical Grinding, Electric Discharge Machining. Get acquainted with the Electron Beam, Laser Beam and Plasma Arc Machining.
CO4	Know the basics of unconventional welding techniques and Solid Phase welding techniques.
CO5	Get acquainted with the basics of advance casting processes.

SYLLABUS- Advanced Manufacturing Techniques--(Elective II)	
Contents	No of hours
Unit I Non Traditional Machining process: Need, classification & historical development. Economics & application of Non-Traditional machining processes. High speed grinding, Hot and Cold machining. ,	08
Unit II Abrasive Jet Machining (AJM): Mechanics of AJM, process parameters and machining parameters. Ultrasonic Machining process: Mechanics and process parameters. Water Jet Machining.	09
Unit III Electro-Chemical Machining: Electrochemistry of ECM. Electrochemical Grinding, Electric Discharge Machining. Electron Beam, Laser Beam and Plasma Arc Machining.	08
Unit IV Unconventional welding techniques such as Oxyacetylene pressure welding, Atomic Hydrogen welding, Stud welding. Solid Phase welding techniques such as Ultrasonic welding, Friction welding with recent development in Welding, Economics and application of Non-Traditional processes for welding.	10
Unit V Advance casting process: Metal mould casting, continuous casting, squeeze casting, vacuum mould casting, evaporative pattern casting, ceramic shell casting, centrifugal casting, slush casting	10

Books Recommended:

1. Manufacturing Science, Ghosh & Malik, East West Press.
2. Advanced Machining Processes, V.K. Jain, Allied Publishers.
3. Introduction to Micromachining, V.K. Jain, Narosa Publishers.
4. Non-Conventional Material Removal Processes, V.K. Jain, IGNOU.
5. Modern Machining Processes, Pandey, Tata McGraw Hill.
6. Textbook of Production Engineering, P.C. Sharma, S. Chand

Reference Book

1. Advanced Machining Processes (Non-Traditional And Hybrid Machining Processes), Hassan El-Hofy, McGraw Hill.
2. Non-Traditional Manufacturing Processes, G.F.Benedict, Marcel Dekker, New York.
3. Manufacturing Engineering & Technology, Serope Kalpakjian, Pearson.
4. Manufacturing Science, M. l. Khan, PHI.
5. Casting Technology & Casting Alloys, A.K. Chakraborty, PHI

List of tutorials: Tutorials based on above syllabus**.**

RTM Nagpur University- Mechanical Engineering
6th Semester-Elective-II
CNC & Robotics –(BEME605T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	CNC & Robotics **(**Elective-II)	03	-	--	3	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	Understand NC, CNC and DNC manufacturing. Evolution and principle of CNC machine tools and different measurement technologies
2	Generate manual part program for CNC machining.
3	To introduce the functional elements of Robotics
4	Concept of industrial robotics and its various applications.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand fundamentals of NC, CNC and DNC.
CO2	Understand basic drives and work holding devices used in CNC
CO3	Understand NC programming.
CO4	Understand history and classification of robots
CO5	Understand Robot end effectors, motion control, programming languages and applications

Syllabus -CNC & Robotics (Elective II), 6th Sem, Mechanical Engineering	
Contents	No of hours
Unit I : Concepts of NC, CNC, DNC. Classification of CNC machines, Machine configurations, Types of control, CNC controllers characteristics, Interpolators. Cutting tool materials, carbide inserts classification, qualified; semi qualified and preset tooling, tooling system for Machining center and Turning center, of CNC Machines. ,	08
Unit II: Drives and work holding devices:- Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines ,	08
Unit III: Programming CNC machines, Part print analysis and Process planning, Advanced Programming features ,Canned cycles, Subroutines, Macros, special cycles etc. APT part programming using CAD/CAM, Parametric Programming. Manual part programming for CNC turning, milling and machining center. Computer assisted part programming techniques , Conversational and Graphics based software, Solids based part programming. Freeform surface machining. Simulation and Verification of CNC programs. ,	09
Unit IV: Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. Robot activation and feedback components. motion analysis and control: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller. End effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics. Positions sensors, velocity sensors, actuators sensors, power transmission system. ,	09
Unit V ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations. ROBOT LANGUAGES: Textual robot Languages, Generation, Robot language structures, Elements in function. ROBOT APPLICATION: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application. Machine vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image. ,	09

References:

Text Books Recommended:

1. Krar, S., and Gill, A., "CNC Technology and Programming", McGraw Hill publ Co, 1990.
2. Lynch, M., "Computer Numerical Control for Machining", McGraw Hill, 1992.
3. Koren Y, "Computer Control of Manufacturing Systems", McGraw, 1986.
4. Fu K.S., Gonzalez R.C., and Lee C.S.G.," Robotics control, sensing, vision, and intelligence", McGraw-Hill Book Co., 1987.
5. Klafter R.D., Chmielewski T.A. and Negin M.," Robot Engineering An Integrated approach", Prentice Hall of India, New Delhi, 1994.

Reference Books Recommended:

1. Gibbs, D., "An Introduction to CNC Machining", Casell, 1987.
2. Seames, W.S., "Computer Numerical Control Concepts and Programming", Delmar Publishers, 1986.

RTM Nagpur University- Mechanical Engineering
6th Sem-(Elective-II)
Design of Heat Exchangers –(BEME605T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	**Elective-II Design of Heat Exchangers**	03	-	-	03	30	70	100	03 Hours

Prerequisites: Engineering Thermodynamics, Fluid Mechanics, Heat Transfer

Sr. No.	Course Objective The objective of this course is–
1	To provide exposure to different kind of heat exchanger, their working and selection for a given application.
2	To analyze the sizing and rating of the heat exchangers for various applications
3	To explain construction and thermal design methodology for Heat Exchangers and use computational tools for designing.
4	To explore different techniques of heat exchanger analysis and evaluate the performance characteristics.
Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the basic design methodologies for heat exchanger, different techniques of heat exchanger analysis and be aware of common heat exchangers with their constructions and working principles
CO2	Learn how to design common types of heat exchangers; namely shell-and-tube, tube and tube, compact heat exchanger and heat pipes micro heat exchangers and double pipe heat exchangers etc.
CO3	Select various TEMA standards and software tool in the designing of different types of heat exchanger.
CO4	Formulate the mathematical model for heat exchanger
CO5	Apply the various concepts to design Direct contact heat exchangers (cooling towers) & Condensors and evaluate the performance of cooling tower

SYLLABUS Design of Heat Exchangers-(Elective-II)	
Contents	No of hours
Unit I: **Different classification and basic design methodologies for heat exchanger:** Classification of heat exchanger, selection of heat exchanger, overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multi-pass and cross flow heat exchanger, e-NTU method for heat exchanger analysis, fouling, cleanliness factor, percent over surface, techniques to control fouling, additives, rating and sizing problems, heat exchanger design methodology.	10
Unit II: **Design of double pipe heat exchangers:** Thermal and hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop. **Design of compact heat exchangers:** Plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop.	9
Unit III: **Design of Shell & tube heat exchangers:** Basic components, basic design procedure of heat exchanger, TEMA standard heat-exchanger nomenclature, TEMA code, standards selection criteria for different types of shells and front and rear head ends; geometrical characteristics of TEMA heat exchangers. J-factors, conventional design methods, Kerns method ,Bell-Delaware method.	08
Unit IV: **Direct contact heat exchangers (cooling towers) & Condensers:** Design considerations for Condensers, Evaporators, Cooling Tower etc. Design of surface and evaporative condensers, Cooling tower Packing's, Spray design, Selection of pumps, Fans and Pipes, Testing ,Maintenance, and performance characteristics of cooling tower	08
Unit V: **Heat Transfer Enhancement and Performance Evaluation:** Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis. Review of mechanical Design, Materials of Construction, corrosion damage, testing and inspection. Use of Software in heat exchanger design, Introduction to Heat pipes and micro Heat Exchanger	09

Sr. No.	List of Tutorials
01	Introduction and classification of Heat Exchangers
02	Basic Design Methods of Heat Exchanger
03	Shell And Tube Heat Exchanger
04	Compact and Plate Heat Exchanger
05	Direct contact heat exchangers (cooling towers) & Condensors:
06	Analysis of heat exchangers

References:

Text Books Recommended:

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
3. Advances in thermal design of heat exchangers: a numerical approach: direct-sizing, step-wise rating, and transients, Eric M. Smith, John Wiley & Sons, 1999.
4. Cooling Tower, Nicholas Cheremistoff, Ann Arbor Science Pub 1981
5. J.P. Gupta, Fundamentals of heat exchangers and pressure vessel technology, Hemisphere publishing corporation, Springer-Verlag (outside NA), 1986
6. Donald Q. Kern and Alban D. Kraus, "Extended surface hear transfer" Mc Graw Hill Book Co., 1972

Reference Books Recommended:

1. Process Heat Transfer, CRC Press, G F Hewuttm G L Shires and T R Bott,1994.
2. Compact Heat Exchangers, Pergamon, J.E. Hesselgreaves, Elsevier science Ltd 2001.
3. Advances in Thermal Design of Heat Exchangers, Eric M Smith, John Wiley & Sons, Ltd., 2005.
4. Heat Exchanger Design, P. O. Fraas, John Wiley & Sons, 1988

Data Books Recommended:

1. Heat exchanger design hand book, Kuppan. T., New York : Marcel Dekker, 2000.
2. Handbook for Heat Exchangers and Tube Banks Design, D. Annaratone , Springer Verlag, 2010.
3. Heat Exchanger Design Hand Book, Schunder E.U, Hemisphere Pub.

RTM Nagpur University- Mechanical Engineering
6th Sem-(Elective-II)
Advanced I C Engines –(BEME605T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	Advance IC Engines [Elective – II]	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To enable the students understand various working cycles, basic components of IC engine, cooling, lubrication and Fuel supply system of IC engine.
2	To enable the students to familiarize with combustion (normal and abnormal) phenomenon in SI and CI engine.
3	To update the knowledge in Alternate fuel, engines exhaust emission and engine testing.
4	To enable the students to understand recent advancement used in IC engine.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand basics of IC Engine, types of IC Engine, working cycle, cooling and lubrication system
CO2	Understand basic fuel, Alternate fuels and fuel supply system in IC engine
CO3	Understand combustion phenomenon in in SI and CI engine.
CO4	Understand the various performance parameters of an engine, testing procedure and its analysis.
CO5	Illustrate emission norms its emission control for engine. Comprehend the different technological advances in engines.

Syllabus- Advanced I C Engines-(Elective-II)	
Contents	No of hours
Unit I :*Basics of IC Engine and its operation:* Introduction, Definition and Function of IC Engine, Various nomenclature of IC Engine, Classification of IC Engine, Engine components and their material, Working of Otto cycle, Diesel cycle and dual cycle on basis of PV Diagram, Theoretical and actual valve timing diagram of 4-Stroke SI and CI Engine, Comparison of SI and CI engines, comparison of two stroke and four stroke Need,requirement and types of Engine cooling lubrication and system.	**[8 Hrs.]**
UNIT – II: *Fuels and its supply system for SI and CI engine:* Important qualities of SI and CI engine fuels, Rating of SI & CI engine fuels, Mixture requirement for different loads and speeds, Alternative fuels used for IC engine (Ethanol, Methanol, Hydrogen, LPG, CNG, Bio gas and Bio-diesel, Hybrid vehicle). SI engine Fuel supply system- Types of fuel supply used, working of simple carburetor and its limitations, Gasoline Injection -advantages and disadvantages. Types of Gasoline Injection – TBI, MPFI, GDI, C.I. Engine Fuel supply system-components of Fuel injection system., D.I. systems and CRDI , types of nozzles. (Numerical on carburetor and fuel injection system)	**[8 Hrs.]**
UNIT – III: *Combustion in S.I. Engine:* Introduction, Stages of combustion in SI Engine, flame front propagation, factors affecting flame front propagation, Abnormal combustion in SI Engine, Factor responsible for abnormal combustion and its control. *Combustion in C. I. Engines:* Charge motion within the cylinder, Air swirl, Methods to generate air swirl, Stages of combustion in C. I. engines, Ignition delay period, factors affecting delay period, Abnormal combustion CI Engine, Factor responsible for abnormal combustion and its control. Importance of supercharging and turbocharging in IC engines.	**[10 Hrs.]**
UNIT IV: *Engine performance parameter and Testing:* Definitions of important engine characteristics of engines Brake, Torque & Power, Mechanical efficiency, Mean effective pressure, Specific fuel consumption and efficiency, Volumetric efficiency. Testing - Measurement of friction power, indicated power (indicator diagram), Brake power, various types of absorption dynamometer, Fuel consumption measurement, Air consumption measurement methods, Engine efficiencies. Variables affecting engine performance characteristics. Heat balance sheet.	**[8 Hrs.]**

UNIT V: *Engine emission and Electronic Engine Controls system:* Constituents of exhaust emission. Factors responsible for formation of NOx, HC, CO and particulate emissions, Methods of controlling emission, Exhaust-Gas recirculation (EGR), Evaporation emission control system. After exhaust treatment system - Secondary air injection system, Catalytic converter. Introduction to Euro norms and Bharat Stage norms, Diesel smoke and its control, Comparison of SI and CI emission. Effect of engine emission on environment and human health. Electronic Control module (ECM),Inputs and output signals of ECM, Various Sensors -Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow ,Manifold absolute pressure , Oxygen sensors their function construction and importance.	**[8 Hrs.]**

Sr. No.	List of Tutorials
01	Introduction, IC engine history and development.
02	Study of cooling and lubrication systems of IC engine.
03	Numerical on fuel supply system of IC engine.
04	Discussion on combustion in SI and CI engine.
05	Numerical on engine testing
06	Discussion on emission, emission norms.

References:

Text Books Recommended:

1. **TEXT BOOKS:**

1. Internal Combustion Engines, M. C. Mathur, R.D. Sharma, Dhanpat Rai & Sons.
2. Internal Combustion Engine, R.K. Rajput, Laxmi Publications.
3.Internal Combustion Engines, V. M. Domkundwar, Dhanpat Rai & Sons.
4. Internal Combustion Engines, V. Ganesan, Tata McGraw Hill.
5. Fundamentals of Internal Combustion Engines, H.N. Gupta, PHI Learning.

Reference Books Recommended:

REFERENCE BOOKS:

1. Internal Combustion Engine Fundamentals, John B. Heywood, Tata McGraw Hill.
2. Internal Combustion Engines and Air pollution, Edward F. Obert, Intex Educational.
3. Automobile Engineering Vol.-2, Dr. Kirpal Singh, Standard Publishers.
4. Automobile Mechanics, Crouse & Anglin, Tata McGraw Hill.
5. I.C. Engine Combustion & Emission, Pundir B.P., Narosa publication.

RTM Nagpur University-Mechanical Engineering
6th Semester
Skill Development -(BEME606P)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assess	University Exam	Total	
B.Tech . 6th Sem Mechanical	**Skill Development**	-	-	4	02	50	--	50	3

Sr. No.	Course Objective The objective of this course is–
1	Apply engineering knowledge, critical thinking, creativity, and problem solving skills with integrity and inclusivity in professional engineering practice
2	Continue intellectual development through graduate education, professional development courses, self-directed investigation, and/or on-the-job training and experience.
3	Embrace leadership and collaborative roles in their careers

Course Outcomes

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

[1] Apply knowledge of mathematics, science, and engineering to mechanical engineering problems.
[2] An ability to design and conduct experiments, as well as to analyze and interpret data.
[3] An ability to design systems, components, or processes to meet desired needs.
[4] An ability to function on multi-disciplinary teams.
[5] An ability to identify, formulate, and solve engineering problems.
[6] An understanding of professional and ethical responsibility.
[7] An ability to communicate effectively with written, oral, and visual means.
[8] The broad education necessary to understand the impact of engineering solutions in a global and societal context.
[9] A recognition of the need for and an ability to engage in life-long learning.
[10] A knowledge of contemporary issues.
[11] An ability to use modern engineering techniques, skills, and computing tools necessary for engineering practice.
[12] An ability to work professionally in either thermal or mechanical systems areas.

Syllabus-6th Semester, Mechanical , Skill Development
Technical Skills

1. Use of Lab Equipment

- Perform testing.
- Equipment familiarization
- Learn to use the equipment and what type of data can be obtained from it.
- To get this experience from internships, lab courses, and working in a professor's research lab.

2. Statistics and Data Analysis

- Use of Minitab

3. Computer Software Skills

- SOLIDWORKS
- Excel

4. Part, Process, and Product Design

- Understanding the New Product Development
- Manufacturing,
- Product design,
- Quality

5. Test Method Development

6. Technical Writing

- Technical reports
- Test methods
- Lab notebooks
- Work instructions
- Emails

7. Create and Read Technical Drawings

- Computer-aided design (CAD)

8. Problem-solving Skills

- The challenges can range from technical issues to people management.
- Students need to identify, assess, take action, and resolve obstacles.

9. Mechanical Aptitude

10. Knowledge of a Specific Topic

Soft Skills

1. Leadership Skills
2. Time Management
3. Effective Communication
4. Attention to Detail
5. Resourcefulness (How to take help of)
    a. Clubs relating to your major
    b. Colleagues and upperclassmen
    c. Professors and teaching assistants
    d. On-campus resources, such as tutoring centers
    e. Blogs and websites
6. Decision-making Skills
7. Negotiating Skills
8. Public Speaking Skills
9. Perseverance
10. Attitude and Motivation:
11. Ability to Work Independently and With a Team
12. Ability to Give and Receive Feedback
13. Adaptability Skills

RTM Nagpur University-Mechanical Engineering
6th Semester
Summer Internship -(BEME607P)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	Summer Internship	-	-	--	--	--	--	--	-

Sr. No.	Course Objective The objective of this course is–
1	An internship is an official program offered by organizations to help train and provide work experience to students and recent graduates. Internships play a crucial role in shaping one's career. It not only helps undergraduates and graduates gain real exposure to working environments but also helps them develop the necessary skills required to stand out in a saturated job market.
2	a) Experience a professional working environment b) Receive Credits for College c) Interns are potential candidates for a new hire d) Build your resume with hard and soft skills e) Learn time management f) Make industry contacts g) Build and practice new skills

Course Outcomes

1. Internships provide exposure to the real world
2. Internships give a platform to establish critical networking connections
3. Internships allow to learn more about yourself
4. Internships equip with more than just technical skills
5. Internships allow to gain a competitive edge

6th Sem, Mechanical , Summer Internship

Students are expected to

1. **Assist and contribute to the team**

Here are some day-to-day intern roles and their responsibilities:

- Performing clerical duties:
- Creating PowerPoint presentations,
- Drafting reports,
- Designing creative,
- Researching trends

2. **Managing social media and emails:** Students may be asked to handle the company's social media accounts, write emails to customers, talk to clients on the phone, and similar duties. It may include designing social media posts, scheduling them and creating a general strategy for your posts.

Event handling: Interns may be asked to oversee the scheduling of important events. Also they may asked to help get everything prepared for an important

Research: Interns fresh from a university education have a great deal of up-to-date knowledge. Organizations may put this knowledge to good use by placing you in a research role. Students may be asked to look into a new project and give your recommendations on how best to execute it.

3. **Learn and gain experience**

Picking up hard skills: Hard skills are the technical skills needed to carry out intern responsibilities, and eventually job duties, successfully.

- Soft skills: Ability to relate to people and build mutually-beneficial relationships.
- Emotional intelligence,
- Motivation, people-skills,
- Listening, Communication.

4. **Job shadow**

As the name suggests, the practice involves "shadowing" someone as they perform their daily duties, observing their activities, and learning what the role entails via indirect experience.

5. **Take on an increasing amount of responsibility**
6. **Network**

While networking isn't an official requirement as such, it might as well be. Networking involves building relationships with bosses, colleagues, and customers and clients.

7. **Make a career call**

RTM Nagpur University- Mechanical Engineering
6th Semester (Mandatory Course)
Environmental Studies –(BEME608T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Audit	GRADES			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
B.Tech 6th Sem Mechanical	**Environmental Studies**	00	-	02	00	Grades O,A,B,C	Grades O,A,B,C	--	--

Sr. No.	Course Objective The objective of this course is–
1	This course provides an integrated and interdisciplinary approach to the study of environment and solutions to environmental problems. This course will spread awareness among the students about environmental issues and shall alert them to find solutions for sustainable development.

GUIDELINES FOR EVALUATION OF ENVIRONMENTAL STUDIES SUBJECT
(As per Ordinance No. 2 of 2012)

In view of the above entire course the students in terms of batches of 20 students each may be assigned a project work encompassing People's Bio-diversity Register (PBR) of any Gram Panchayat as per the format of Bio-diversity Authority of India under the guidance of a teacher. The PBR should be evaluated for 100 marks.

The result shall be declared in grades as follows:

Grade O: above 75 Marks; Grade A: 61–75 Marks; Grade B: 51-60 Marks; Grade C: 40-50 Marks

Syllabus Environmental Studies, 6th Semester, Mechanical Engineering	
Contents	No of hours
Unit I : Definition, scope and importance; Need for public awareness -Institutions in environment,people in environment.	04
Unit II: Renewable and non-renewable and associated problems; Role of an individual in conservation ofnatural resources; equitable use of resources for sustainable lifestyles.	04
Unit III: Concept of an ecosystem - understanding ecosystems, ecosystem degradation, resource utilization, Structure and functions of an ecosystem- producers, consumers) and decomposers. Energy flow in the ecosystem - water, carbon, oxygen, nitrogen; and energy cycles, integration of cycles in nature. Ecological succession; Food chains, food webs and ecological pyramids; Ecosystem types - characteristic features, structure:, and functions of forest, grassland, desert and aquatic	04
Unit IV: Introduction - biodiversity; at genetic, species and ecosystem levels Bio-geographic classificationof India Value of biodiversity - Consumptive use value, productive use .value, social, ethical, moral,aesthetic and optional value of biodiversity .India as a mega-diversity nation; hotspots of biodiversity Threats to bio-diversity - habitat loss, poaching of wildlife, man-wild life conflicts. Common endangered and endemic plant and animal species of India. Insitu and Exsitu conservation of biodiversity	04
Unit V Definition; Causes, effects and control measures of air, water, soil, marine, noise and thermal pollutions and nuclear hazards. Solid waste management - Causes, effects and control measures of urban and industrial waste. Roleof individual and institutions in prevention of pollution. Disaster management Floods, Earth quacks, Cyclone and land slides	04

References:

Text Books Recommended:

1. A Text Book of Environmental Studies for Undergraduate Courses, Erach Bharucha, University Press (India) Pvt. Ltd., Hyderabadintelligence", McGraw-Hill Book Co., 1987.