Annexure - B

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering)

V Semester B.E. (Mechanical Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme								
		Hours per week			No. of Credits	Theory					Practical			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks University Assessment	Max. Marks College Assessment	Total Marks	Min. Passing Marks	Max. Marks University Assessment	Max. Marks College Assesment	Total Marks	Min. Passing Marks
BEME501T	Industrial Economics and Entrepreneurship Development	03	01	-	04	03	80	20	100	40	-	-	-	-
BEME502T	Design of Machine Elements	03	01	-	04	03	80	20	100	40	-	-	-	-
BEME503T	Advanced Production Processes	03	01	-	04	03	80	20	100	40	-	-	-	-
BEME504T	Heat Transfer	03	01	-	04	03	80	20	100	40	-	-	-	-
BEME504P	Heat Transfer	-	-	02	01	-	-	-	-	-	25	25	50	25
BEME505T	Mechanical Measurement & Metrology	03	01	-	04	03	80	20	100	40	-	-	-	-
BEME505P	Mechanical Measurement & Metrology	-	-	02	01	-	-	-	-	-	25	25	50	25
BEME506P	Computer Applications – I	-	02	02	04	-	-	-	-	-	50	50	100	50
BEME507P	Industrial Visit	-	-	02	Audit Course									
Total		**15**	**07**	**08**		**-**	**400**	**100**	**500**	**-**	**100**	**100**	**200**	**-**
Semester Total		**30**			**26**	**Marks 700**								

Industrial Economics and Entrepreneurship Development (BEME501T) subject pertains to Board of Studies in Applied Sciences & Humanities and all the remaining subjects pertain to the Board of Studies in Mechanical Engineering.

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Engineering and Technology

B.E. (MECHANICAL ENGINEERING): FIFTH SEMESTER

BEME501T: INDUSTRIAL ECONOMICS AND ENTREPRENEURSHIP DEVELOPMENT (Theory)

CREDITS: 04

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

Course Objectives and Expected Outcomes: This course is designed to create awareness about economics terminology and business organization, to understand relationship between business, market and society, to create awareness about entrepreneurship as a career avenue; financial agencies and government support systems for entrepreneurship. This course shall stimulate the potential to develop entrepreneurial orientation through innovation, creativity & students will understand the concept of innovation, invention, creativity and discovery in engineering context and shall also get awareness about IPR and Patents.

UNIT – I **[8 Hrs.]**

Industrial Economics : Economics, classification of economics, Basics concepts, Law of demand, Demand analysis, Types of demand, Determinants of demand, Methods of demand forecasting, Supply, Law of diminishing marginal utility, Elasticity of demand, Types of elasticity of demand.

UNIT – II **[8 Hrs.]**

Factors of production, Production function, Firm and Industry, Law of return, Cost concepts, Fixed variable, Average, Marginal and Total cost, Break even analysis Depreciation and methods for depreciation.

UNIT – III **[8 Hrs.]**

Inflation, effect of inflation, Monetary and fiscal measures to control inflation, deflation, stagflation direct and indirect taxes. Market and market structures, Perfect competition, Monopoly, Monopolistic competition, Oligopoly, Price determination in these Situations. Concept & overview of share market, Effect of share market on economy, Share market terminologies.

UNIT – IV **[8 Hrs.]**

Innovation & Creativity: Concept of creativity, innovation, invention, discovery. Methods for development of creativity, convergent & divergent thinking etc. Introduction to Intellectual Property Rights (IPR), Patent and laws related to patents.

UNIT – V **[8 Hrs.]**

Concept of entrepreneurship, its relations in economic developments, Eventuation of concept of entrepreneur, characteristics of an Entrepreneur, Types of entrepreneurs, Qualities of entrepreneur, Factors affecting growth of entrepreneurship. Theory of achievement, motivation, Medelland's. experiment, Women entrepreneurship, Role of SSI, it's advantages & limitations, policies governing small scale industries, Procedure to set up small scale industrial unit, Advantages and limitations of SSI.

UNIT – VI **[8 Hrs.]**

Preparation of project report: Factors governing project selection, Market survey, Preparation of project report. Financial, technical & market analysis of project. Entrepreneurial support systems, Role of consultancy organization like, District Industrial Centre, State Industrial Development Corporation, Financial institution, Latest SSI schemes of DIC (to be confirmed from DIC from time to time)

Note: Group of students (Min 05 & Max 09) are expected to prepare a project report for business / industry on the knowledge acquired.

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. Entrepreneurship Development, S. S. Khanka, S. Chand Publishers
5. Creativity Innovation & Entrepreneurship, Zechariah James Blanchard, Needle Rat Business Publishers.

BEME502T: DESIGN OF MACHINE ELEMENTS (Theory)

CREDITS: 04

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours
Tutorial: 1 Hour/Week	University Assessment: 80 Marks
	College Assessment: 20 Marks

Course Objectives and Expected Outcomes: This course is designed to understand the basic machine element design. It includes the procedure of design (w.r.t. basic failures) under various loading conditions. Students shall understand design of various mechanical joints, machine components such as shaft, keys, brakes clutches, power screws etc. Apart from this, students shall learn spring design & pressure vessel design. At the end of this course, students will get familiar with design of these mechanical components under various loading conditions.

UNIT – I **[12 Hrs.]**

Introduction to Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics Consideration in design , Material properties and their uses in design , Basic 'principles of Machine Design, Modes of failures, I. S. codes, Preferred Series and numbers. Design of Knuckle joint, Socket & Spigot type cotter joint. Design of riveted joint.

UNIT – II **[12 Hrs.]**

Design of bolted and welded joints under axial and eccentric loading conditions. Design of Brackets & Levers.

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.

UNIT – III **[12 Hrs.]**

Design of shaft for power transmission, static and fatigue criteria for shaft design, ASME codes for shaft design, Design of keys.

Design of Springs: Spring material, Helical compression & tension springs under static and variable loads, Leaf spring, Laminated Springs.

UNIT – IV **[12 Hrs.]**

Design of power screw: Thread forms, multiple threaded screws, terminology of power screw, design of screw jack.

Design of clutches and brakes: Single and multiple plate clutch, constant wear and constant pressure theory for plate clutches, Internal and external shoe brakes.

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TEXT BOOKS:

1. Design of Machine Elements, B.D.Shiwalkar, Central Techno Publications
2. Design of Machine Elements, V. B. Bhandari, Tata McGraw Hill Pub.
3. Mechanical Engineering Design, J. E. Shigley, McGraw Hill.
4. Design Data Book, B.D.Shiwalkar, Central Techno Publications.
5. Design Data Book, PSG.
6. Design Data Handbook Book, K. Mahadevan, CBS Publishers.
7. Mechanical Design of Machine Elements & Machines, J.A.Collins, Wiley India
8. Machine Components Design, Robert C., Juvinall & Kurt M. Marshek, Wiley India
9. Machine Design, U.C. Jindal, Pearson Publications
10. Machine Design : An Integrated Approach, Robert L Norton, Pearson Publications
11. Machine Design Fundamental and Applications, P.C. Gope, PHI Learning.
12. Design of Machine Elements, Sharma C.S. & Purohit K, PHI Learning.

REFERENCE BOOKS:

1. Design of Machine Elements, Spotts M. F. and Shoup T. E., Pearson Publications.
2. Machine Design, Black P. H. and O. Eugene Adams, McGraw Hill Book Co Inc.

BEME503T: ADVANCED PRODUCTION PROCESSES (Theory)

CREDITS: 04

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

Course Objectives and Expected Outcomes: This subject is designed to make conversant with non conventional machining processes, advanced Joining Processes, Die Cutting Operations, Jig and Fixtures, Super -finishing operations & Machining centre. Upon completion of this course, student shall understand the unconventional machining processes and will be able to select and apply suitable processes for engineering products.

UNIT – I **[8 Hrs.]**

Non- conventional machining Processes: Introduction & classification, Electrochemical machining, Electrical Discharge machining, Ultrasonic machining, Laser beam machining, Electron beam machining, Water jet machining, Abrasive jet machining. Advantages, disadvantages and applications of above processes.

UNIT – II **[8 Hrs.]**

Advanced joining Processes : Introduction and classification of welding techniques, Advanced welding processes such as TIG, MIG welding, Plasma arc welding, Plasma welding, Oxyacetylene welding , Atomic hydrogen welding , Laser beam welding , Electron beam welding , Electro slag welding.

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UNIT – III **[8 Hrs.]**

Advanced machining Processes: Introduction, Classification, Capstan and turret lathe, Tool layout for capstan and turret lathe, Machining center.
Introduction to micromachining, nanofabrication, high energy rate forming.

UNIT – IV **[8 Hrs.]**

Die cutting operations: Introduction, Sheet metal cutting, Sheet metal forming, Sheet metal drawing, defects in drawn parts, Spinning, Equipments for sheet metal working, Die and punch.

UNIT – V **[8 Hrs.]**

Jigs and fixtures: Introduction, principles of jig and fixture, Principle of location, jig bushes, drilling jigs, type of clamps, classification of fixtures.

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UNIT – VI **[8 Hrs.]**

Super finishing processes: Introduction, Principle of super finishing process, Lapping, Honing, Buffing & Electroplating.
Principle of operation, advantages, disadvantages and applications of above processes. Application of LASER in surface modification.

Note: All the teachers are advised to show the relevant videos for the above processes.

TEXT BOOKS:

1. Production Technology, P.C. Sharma, S.Chand Publication.
2. Manufacturing Engineering and Technology, Serope KalpakJan, Pearsons.
3. Manufacturing Technology, D.K. Singh, Pearsons.
4. Unconventional Manufacturing Processes, M.K. Singh, New Age Publications.
5. Non-Conventional Manufacturing Processes, H.S. Shan, Tata Mc-Graw Hill.

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BEME504T: HEAT TRANSFER (Theory)

CREDITS: 04

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

Course Objectives and Expected Outcomes: This course is designed to learn the various modes of heat transfer and laws associated with it. During this course, students can distinguish between steady state and unsteady state heat transfer; will be able to apply their knowledge of Dimensional Analysis to forced and free convection. Students will also be able to analyse radiation with and without radiation shield. Apart from this, students will also be able to analyse & design heat exchangers.

UNIT – I **[8 Hrs.]**

Introduction to basic modes of heat transfer, conduction, convection & radiation. Laws of heat transfer & conservation of energy requirement. 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.

UNIT – II **[8 Hrs.]**

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 heat transfer rate, fin efficiency & effectiveness. Error in temperature measurement. Unsteady state heat transfer, lumped heat capacity analysis, Heisler's charts. Biot Number, Fourier's Number & its significance.

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UNIT – III **[8 Hrs.]**

Forced convection, physical significance of non-dimensional parameter. Flow of high, moderate & low Prandtl number, fluid flow over a flat plate. 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. Dimensional analysis applied to forced convection.

UNIT – IV **[8 Hrs.]**

Free or natural convection. Grashoff's number, Rayleigh number, flow over horizontal and vertical plate, Empirical Co-relations for cylinders and spheres, heat transfer with phase change, pool boiling curve & regimes of pool boiling, Film & Drop wise condensation, laminar film condensation on vertical surface, on horizontal tubes, effect of super heated & non-condensable gases on condensation heat transfer, Dimensional analysis applied to free or Natural convection.

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UNIT – V **[8 Hrs.]**

Radiation, spectrum of radiation, black body radiation, radiation intensity, laws of radiation- Kirchoffs, Plancks, Weins displacement law, Stefan Boltzmann & Lamberts Co-sine law. Emissivity, Absorbtivity, Transmissivity, Reflectivity, Radiosity, Emissive power, Irradiation. Radiation network, radiation exchange between parallel plate cylinder & sphere, shape factor & its laws, radiation between parallel plates, cylinder & spheres. Radiation shields.

UNIT – VI **[8 Hrs.]**

Heat exchanger : Classification, overall heat transfer coefficient, fouling factor, LMTD & effectiveness, NTU method of heat exchanger analysis for parallel, counter flow & cross flow arrangement, design aspect of heat exchangers, Introduction to compact heat exchanger, Heat Pipe, Introduction to mass transfer.

TEXT BOOKS:

1. Heat Transfer, J.P. Holman, McGraw Hill Book Company, New York.
2. Fundamentals of Heat and Mass Transfer, K. N. Seetharam & T.R. Seetharam, Willey.
3. A Text Book of Heat Transfer, S.P. Sukhatme, University Press.

REFERENCE BOOKS:

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: Heat & Mass Transfer, Domkundwar, Dhanapat Rai & Sons Publication.

BEME504P: HEAT TRANSFER (Practical)

CREDITS: 01

Teaching Scheme	**Examination Scheme**
Practical: 2 Hours/Week	University Assessment: 25 Marks
	College Assessment:25 Marks

LIST OF PRACTICALS:

Minimum Eight out of the following shall be performed (Out of which Six must be experimental):

1. To determine the thermal conductivity of composite wall.
2. Determination of thermal conductivity of an insulating powder.
3. Determination of thermal conductivity of metal bar.
4. Determination of Stefan Boltzmann constant.
5. Determination of temperature distribution & heat transfer rate from fin under forced convection.
6. Determination of heat transfer coefficient in natural convection for vertical tube.
7. Determination of condensation heat transfer coefficient in film wise & drop wise condensation.
8. Determination of emmissivity of non black body.
9. Study of various types of heat exchangers.
10. Computerized analysis of various parameters of heat exchanger using shell and tube heat exchanger.
11. Study of heat pipe.

BEME505T: MECHANICAL MEASUREMENT & METROLOGY (Theory)

CREDITS: 04

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

Course Objectives and Expected Outcomes: This course is designed to study various measurement systems and their significance along with the characteristics and order of the instruments. At the end of this course, students will be able to understand various instruments for the measurement of different parameters, tolerances, advanced concepts involved in measuring technology (Measurements) & use of precision measuring instruments. Students will appreciate the importance of accuracy and its effects on results and its uncertainty.

UNIT – I **[8 Hrs.]**

Purpose, structure and elements of measuring system. Static characteristics of measurement system, elements including systematic, statistical characteristics, generalized model of system elements and calibration. Error measurement, error probability density function, error reduction. Introduction to dynamic characteristics of measurement system. Introduction to noise in measurement system.

UNIT – II **[8 Hrs.]**

Classification, Principle, Sensing elements, Signal conditioning elements, Construction, Range and working of instruments for measurement of Linear and Angular Displacement, Speed, Load, Strain, Force, Torque and Power. (Analytical treatment not included)

UNIT – III **[8 Hrs.]**

Classification, Principle, Sensing elements, Signal conditioning elements, Construction, Range and working of instruments for measurement of Pressure, Vacuum, Sound, Light and Temperature. (Analytical treatment not included)

UNIT – IV **[8 Hrs.]**

Standards of Measurement, Line, End and Wavelength standard. Working standards, Requirement of interchangeability, Allowance and Tolerance, Selective assembly. Measurement of Straightness and Flatness. Instruments for Linear and Angular Measurement. (Vernier, Angle gauge, Sine bar, Level indicator, Clinometers and Taper gauge)

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UNIT – V **[8 Hrs.]**

Limits and Fits, Tolerance analysis of Limits and Fits, Types of limit gauges, Types of fit, Shaft and Hole basis system, Design of Limit gauge and Process planning sheet (Numerical treatment is expected).

UNIT – VI **[8 Hrs.]**

Comparators: Mechanical, Optical, Electrical, Electronic, Pneumatic.

Study and use of Optical profile projectors, Tool maker's microscope and Autocollimator. Measurement of Screw thread and Gear tooth.

LIST OF TUTORIALS:

1) Study of Linear and Angular measurement instrument.
2) Study of various types of Comparators.
3) Preparation of Process Planning sheet.

TEXT BOOKS:

1. Mechanical Measurement and Control, D.S. Kumar, Metropolitan Book Co.
2. Instrumentation Measurement and Analysis, B.C. Nakra, K.K. Choudhary, TMH
3. Measurement Systems, Ernest O. Doebelin, Dhanesh N. Manik, TMH
4. Mechanical Measurement, Thomas G. Beckwith, Pearson
5. Metrology and Measurement, Anand K. Bewoor, Vinay A. Kulkarni, TMH
6. Metrology, R. K. Jain, Khanna Publishers.
7. A Textbook of Engineering Metrology, I. C. Gupta, Dhanpat Rai & Sons Publication.

REFERENCE BOOKS:

1. Principles of Measurement Systems, John P. Bentley, Pearson

BEME505P: MECHANICAL MEASUREMENT & METROLOGY (Practical)

CREDITS: 01

Teaching Scheme	**Examination Scheme**
Practical: 2 Hours/Week	University Assessment: 25 Marks
	College Assessment:25 Marks

LIST OF PRACTICALS:

Minimum Eight out of the following shall be performed:

1. Static characteristic of at least one Instrument.
2. Static calibration of at least one Instrument.

3, 4 & 5. – Measurement of parameters by minimum three different types of Instruments.

6. Measurement of Linear, Angular dimensions (Using Vernier, Sine bar, Clinometers)

7. Measurement of Flatness & Straightness.

8. Study and Measurement of Parameters using Toolmaker's microscope.

9. Study and Measurement of Parameters using Optical profile projector.

10. Use of Optical flat.

11. Design of Limit gauge.

BEME506P: COMPUTER APPLICATIONS – I (Practical)

CREDITS: 04

Teaching Scheme	**Examination Scheme**
Practical: 2 Hours/Week	University Assessment: 50 Marks
Tutorial: 2 Hour/Week	College Assessment:50 Marks

Course Objectives and Expected Outcomes: This course is designed to acquaint the students to solve engineering problems using computers with knowledge of C/C++ programming. Students will be able to write the programs for Numerical Methods & for problem solving in the area of Mechanical Engineering. Students will also understand the concept of OOPs and will get introduced with mathematical softwares.

Review – C/C++ Programming basics, algorithm, types of algorithms, data type, variables, control structures, arrays, vectors, pointers, functions, file handling etc., Basic of OOPS, and Object modeling.

Exposure to Software/s like MATLAB/ MATHCAD/ SCILAB / MATHEMATICA or any other relevant commercial software/s or freeware/s.

LIST OF PRACTICALS:

Minimum eight practicals in following areas shall be performed.

1. Development of application programs in C / C++ exploring use of functions, vectors, arrays etc.
2. Development of programs in C / C++ for any Numerical methods like Newton Raphson, Gauss-Elimination, Gauss-Jordan, Crout's method and Gauss-Seidel Method.
3. 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.
4. Development of programs in C / C++ to solve the problem in the following areas of Mechanical Engineering like, Mechanics, Kinematics of Machines, Engineering Thermodynamics, Hydraulic Machines, Mechanics of Material, Design of Machine elements, Heat Transfer etc.
5. Application of Mathematical Software/s for solution of problems in the areas of Mechanical Engineering.

Note:

During University practical examination of 50 marks, students are expected to prepare & execute computer program/s in C/C++ and/or problem solving using mathematical softwares

of total 30 marks in two hours duration. Viva-Voce of 20 marks shall be conducted during University practical examination.

TEXT BOOKS:

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.

REFERENCE BOOKS: User/Command/Tutorial Manuals of relevant Softwares.

BEME507P: INDUSTRIAL VISIT

CREDITS: Nil (Audit Course)

Teaching Scheme
Practical: 02 Hour/Week

Course Objectives and Expected Outcomes: This subject aims at giving practical exposure to students and to provide opportunities for acquiring knowledge regarding manufacturing and service industries/organizations and to acquaint them with industrial culture. Upon completion of this course, students will be able to describe the usage of different technologies/tools/concepts related to Design process, operation of various machines, mechanical drives, manufacturing processes, machining processes, various process equipments, production techniques, quality control, maintenance practices, automation in industries, management etc.

Students shall visit different industries (at least two). Students shall be preferably divided into small groups to tour around the industry.

After each visit, each batch of students is required to submit a written report and shall give a brief oral presentation.