RTM Nagpur University-Mechanical Engineering
B.Tech 6th Semester
Automation in Production (BTME601T)
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	-	-	3	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 (BTME601T)	
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
B.Tech 6th Semester
Automation In Production (BTME601P)
Syllabus (Theory)

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 LAB	-	-	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 (BTME601P) 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 B.Tech

Energy Conversion-II (BEME602T)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examine	Total	
B. Tech 6thSem Mechanical Engineering	Energy Conversion-II	3	-	-	3	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 construction and operation of Internal combustion (I.C.) Engines, Air Compressors, Refrigeration and Air-conditioning systems.
4.	To analyze the performance of I.C. engines & air compressors, refrigeration and air conditioning systems installations.

Course Outcomes

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

CO1	***Explain, classify &analyze*** the I. C. Engine and ***explain*** the phenomenon of stages of combustion in S.I & C.I Engines, knocking, supercharging and fuel supply systems.
CO2	***Evaluate*** the performance parameters of I.C. Engine and able to prepare heat balance sheet for I.C. Engine.
CO3	***Explain*** the working of Refrigeration systems and ***solve*** the problems related to single stage vapor compression refrigeration cycle.
CO4	***Explain*** the working of Air conditioning systems and ***solve*** the simple problems based on psychometric properties and processes.
CO5	***Explain, classify & compare*** the Air compressors and ***evaluate*** the performance parameters of reciprocating air compressor.

Syllabus -Energy Conversion-II (Theory), 6th Semester B.Tech. 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 and 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 analysis, performance characteristics, factors influencing the performance of I.C. Engines.	08
Unit III **Refrigeration**: Introduction, definition & unit of refrigeration, COP, Air refrigeration system. Refrigerants – Properties, classification, nomenclature, Ozone depletion. Single stage vapours compression refrigeration system, effect of sub-cooling and superheating on COP with P- h and T-S diagram. Mathematical analysis of Simple vapour compression refrigeration system. Vapor absorption refrigeration system (concept only), Three fluids Vapor absorption refrigeration system.	08
Unit IV **Air conditioning**: Introduction, psychometric properties, psychometric processes such as heating, cooling, humidification & dehumidification, psychometric charts, human comfort and factors affecting comfort, Bypass factor, application of Psychrometric to simple air conditioning systems. Air Conditioning systems: classification, Summer & winter air conditioning system, Window air conditioner, Split air conditioner, Inverter Air conditioner. (concept only)	08

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 of Roots blower, vane type, screw type , Centrifugal compressor, Axial flow compressor (concept only)	10

References- Energy Conversion-II

Text Books Recommended:

1. Basic and Applied Thermodynamics-P.K. Nag, Tata McGraw Hill publication.
2. Thermal Engineering- R. K. Rajput, Laxmi publications.
3. Refrigeration and Air Conditioning- C.P. Arora, Tata McGraw Hill publication.
4. A Course in Refrigeration and Air Conditioning- Arora and Domkundwar, Dhanpat Rai and Sons Publication.
5. Internal Combustion Engine –V Ganesan , Tata McGraw Hill publication
6. Thermal Engineering- P.L. Ballaney, Khanna publication.

Reference Books Recommended:

1. Thermal Engineering, Mathur & Mehta, Jain Brothers Publications, New Delhi
2. Internal Combustion Engines-E. Obert, Intex educational publication.
3. Internal combustion engine fundamentals- John Heywood, Tata McGraw Hill publication
4. Principles of Refrigeration-Roy Dossat, Pearson Education publication.
5. Refrigeration & Air conditioning- Stocker & Jones, Tata McGraw Hill publication.

RTM Nagpur University-Mechanical Engineering6th 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 performance parameters of I.C. engines & air compressor
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	**Understand** and **identify** the different components of I.C. engine, air compressor and Vapour Compression Refrigeration system(VCRS)
CO2	**Demonstrate** and **determine** the performance parameters of I.C. engine and preparation of its Heat balance sheet
CO3	**Determine** B.E, IP, and F.P. by using Morse Test on Multi cylinder C.I. Engine or S.I. Engine
CO4	**Demonstrate** and **determine** the performance parameters of Vapour Compression Refrigeration system.
CO5	**Analyze** the performance parameters of Multistage reciprocating air compressor

Sr. No.	List of Practical
Minimum eight experiments out of the following shall be performed	
01	Study and demonstration of Internal Combustion (I.C) engine and its components.
02	Study and demonstration of Valve Timing diagrams for I.C. engine.
03	Study and demonstration of fuel injection systems and ignition systems of I.C. Engines.
04	Performance testing of two stroke / Four stroke Multi cylinder C.I. or S.I. engine
05	Preparation of heat Balance Sheet for C.I. or S.I. engine
06	Performance testing of variable compression ratio engine
07	Morse test on Multi cylinder C.I. or S.I. engine
08	Study & demonstration on household refrigerator.
09	Performance testing of vapour compression refrigeration system
10	Study of vapour absorption refrigeration system
11	Demonstration to study Psychometric Processes on mini-air conditioning tutor.
12	Performance testing of multi stage Reciprocating air compressor
13	Performance testing of Centrifugal or Axial flow air Compressor

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. 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. Internal combustion engine fundamentals, by: John Heywood, pub.: McGraw- Hill .

RTM Nagpur University- Mechanical Engineering
B.Tech 6th Semester
Dynamics of Machines (BTME603T)
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	-	-	03	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.

.

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
B.Tech 6th Semester
Dynamics of Machines Lab (BTME603P)
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 Machines Lab	-	-	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.

.

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 Vibrationsl, S. S. Rao, Addison-Wesley Longman

RTM Nagpur University-Mechanical Engineering
B.Tech 6th Sem-(Elective-I)
Operation Research(BTME604T)
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	-	-	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(BTME604T)-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
B.Tech 6th Sem- (Elective-I)
Production Planning and Control-(BTME604T)
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	30	70	100	3 hrs
		3	-	-					

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 Managementl, S. Chand, New Delhi (2009)

2.Buffa, -Modern Production operations Managementl, Wiley Eastern, New York (1999)

3. Panneer Selvan R, -Production and Operations Managementl, Prentice Hall India, New Delhi (2002)

RTM Nagpur University-Mechanical Engineering
B.Tech 6th Sem- (Elective-I)
Tool Design-(BTME604T)
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-I)	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:

RTM Nagpur University Mechanical Engineering
B.Tech. 6th Semester (Elective-I)
Renewable Energy Sources BTME(604T)
Syllabus- Theory

Semester	Course Title(Subject)	Hours /Week			Credits	Maximum Marks			ExamDuration (Hrs.)
		L	T	P		Continual Assessment	University Examine	Total	
VI	Renewable Energy Resources	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1.	To make the students conversant with the non-conventional energy resources, its need, and their utilization to harness the power.
2.	The students will learn the solar energy utilization with its applications.
3.	The students will understand the various methods by which energy can be generated from wind, ocean tides, Fuel Cell, Geothermal phenomenon, Biogas and MHD

Course Outcomes At the end of the course students will be able to	
CO1	Recognize the need of renewable energy sources.
CO2	Understand various solar thermal energy conversion systems and solar photovoltaic systems in detail.
CO3	Describe different biogas plants, bio-diesel production method and potential of hydrogen as a fuel.
CO4	Explain the working principle of Wind energy systems and ocean thermal energy conversion systems
CO5	Describe the working of Fuel cell system, Geothermal &Magneto hydro dynamic (MHD) power generation systems and Understand the principles of energy conservation.

Syllabus Elective-I Renewable Energy Sources

Contents	No of hours
Unit I Global energy scenario, Indian energy scenario, Environmental aspects of energy utilization, conventional and non-conventional sources of energy, merits, and challenges. Solar Energy: Introduction, solar constant, spectral distribution of solar radiation, beam & diffuse radiation, advantages of solar energy **Solar electrical energy conversion:** Construction and working of solar cells and PV modules, different PV technologies, Photovoltaic system components and different applications	07
Unit II **Solar Thermal Energy Conversion:** Solar flat plate collectors: Types of collectors, liquid flat plate collectors, solar air heaters, Concentrate collectors: line focusing, point focusing and non-focusing type, central receiver concept of power generations, compound parabolic collector, comparison of flat & concentric collectors. Solar Ponds, Solar Cookers, Solar energy storage, sensible, latent and thermochemical storage.	07

Unit III **Energy from Biogas**: - Introduction, bio gas generation, fixed dome & floating drum biogas plants, their constructional details, raw material for biogas production, factors affecting generation of biogas, digester design considerations, fuel properties of biogas and utilization of biogas. Bio Mass: Introduction, methods of obtaining energy from biomass, thermal gasification. **Biodiesel:** Types of biodiesel, Trans-esterification process, Properties and application	08
Unit IV **Wind Energy**: Wind characteristics and site selection, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power. Wind energy conversion systems; Types of WECS and their characteristics, components, Working of horizontal and vertical axis wind turbine machines. **Ocean Energy**: Tidal power plants: single basin and two basis plants, Variation in generation level ; Ocean Thermal Electricity Conversion (OTEC) ; Electricity generation from Waves : Shoreline and Floating wave systems	08
Unit V **Hydrogen Energy:** Properties of Hydrogen with respect to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water **Fuel Cell Technology**: Introduction, Principle of working, Types of fuel cells, Fuel cell efficiency **Geothermal energy**: Introduction, classification of geothermal systems, vapour dominated, liquid dominated system, petrothermal systems, magma resources, applications of geothermal energy	06

References

Text Books Recommended:

1. Non-Conventional Energy Sources, G.D. Rai, Khanna publishers.
2. Non-Conventional Energy Resources: B.H. Khan, Tata McGraw Hill.
3. Solar Energy Utilization, G.D. Rai, Khannapublishers.
4. Industrial Energy Conservation, D. A. Ray, Pergaman press

Reference Books Recommended:

1. Renewable Energy Sources and Emerging Tech., Kothari, PHI.
2. Solar Energy, S.P. Shukhatme, Tata McGraw Hill Education.
3. Renewable Energy Recourses: Basic Principle and Applications: G.N. Tiwari andM.K. Ghosal, Narosa publication.

RTM Nagpur University- Mechanical Engineering
B.Tech 6TH SEM-(Elective II)
Advanced Manufacturing Techniques-BTME605T
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	Advanced Manufacturing Techniques (Elective II)	3	-	-	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, Projection Welding,Seam Welding, Plasma Arc 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, Investment Casting, Design of Gating System and Riser Design	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. I. Khan, PHI.
5. Casting Technology & Casting Alloys, A.K. Chakraborty, PHI

List of tutorials: Tutorials based on above syllabus.

RTM Nagpur University-Mechanical Engineering
B.Tech 6th Sem- (Elective-II)
Power Plant Engineering-(BTME605T)
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 II)	3	-	-	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
B.Tech 6th Sem- (Elective-II)
Supply Chain Management-(BTME605T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Supply Chain Management (Elective-II)	3	-	-	3	30	70	100	3

Sr. No.	Course Objective
1	Reduce operating expenses
2	Enhance customer satisfaction
3	Improve distribution channel
4	Strengthen financial position of the company & Promote better coordination
5	Regulate proper inventory

Course Outcomes After Sucessful Completion of the Course Students will be able to:	
CO1	Identify Scope and Importance of Supply chain Management
CO2	Understand difference between Transportation & Distribution & their channels
CO3	Plan for Inventories leading to shorter delivery and sourcing time
CO4	Implement strategies and classify them according to requirements
CO5	Plan activities and documentation requirements along with MIS

Syllabus-SUPPLY CHAIN MANAGEMENT-

Contents	No o hour
Unit I Introduction to SCM Meaning, Importance, Overview, Objective, Process Overview, Process tools, Supply chain dynamics, Focus areas in SCM, Change Drivers, Evolution of SCM, Types of Cargoes. Cross docking warehousing, Agile SCM, Green SCM, Maritime SCMs.	8hrs
Unit IISupply Chain Network Design and Demand Management Logistics and SCM Network design, Integrated SCM Planning, Strategic Importance of Logistics/SCM network planning, Factors influencing network design decisions, Major Locational determinants, Framework - Design – and Functions, Types and Functions of Distribution Channel, Physical Distribution Management, Tasks in Physical Distribution Channel, Economic of distribution, Channel Relationships, Logistics service alliances, Alliances, Modelling approaches to Logistics/ Supply chain network design, Strategic Planning of logistics. Supply chain network, Demand Management, Relationship between customer service and demand management, Performance measures for customer service. Demand management process,	8hrs
Unit III **Supply Chain Planning, implementation and order processing with IT**-Aggregate planning in a supply chain, Aggregate planning strategies, Planning supply and demand in a supply chain, Planning and managing inventories in a supply chain, Planning for optimal level of product availability, Sourcing/source management, Strategic sourcing management / Transportation management The customer order cycle, Order management system, Order and replenishment cycles, Order processing categories, The logistics information system, The order management system, The warehouse management system, The transportation management system.	8 hrs
Unit IV Supply Chain Planning and Strategies Supply chain strategies, Strategy classification, Corporate strategy, Logistics strategies, Strategic fit, Achieving strategic fit, Supply chain strategies, Supply chain strategy framework, Supply chain relationships, Customer relationship management, Supply chain integration, Push, Pull and Push Pull systems, Demand-driven strategies, Distribution strategies, Centralised control strategy versus decentralized control strategy	8hrs
Unit V Location and Transportation Strategy in Supply Chain The need for long range planning, Major locational determinants, Historical perspectives on location problems, Single facility versus multi facility location, Methods of evaluating location alternatives The role of transportation in a supply chain, Traffic and transportation strategy, Carrier selection decision, Inter-model transportation, Transport documentation, Transportation economics and pricing costing of transportation services, Rate and rating, Transportation management strategy, Transportation Management System (TMS), Transportation services, Transportation cost considerations, Transportation rate profiles, Transportation documents used in International transportation, and Domestic transportation.	8hrs

Text Books Recommended:

1. K. ShridharaBhat, Supply Chain Management, Himalaya Publishing House, Latest Edition

2. Sunil Chopra, Peter Meindl, DharamVirKalra Supply Chain Management – Strategy, Planning and Operation, Pearson Latest Edition

Reference Books Recommended:

1. SarikaKulkarni, Ashok Sharma Supply Chain Management – Creating Linkages for Faster Business Turnaround, Tata McGraw-Hill Publishing Company Ltd, Latest Edition
2. 2. James B. Ayers, Supply Chain Project Management – A Structured Collaborative and Measurable Approach, CRC Press, Latest Edition

RTM Nagpur University- Mechanical Engineering
B.Tech 6th Semester-Elective-II
Introduction to Artificial Intelligence (BTME605T)
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	Introduction to Artificial Intelligence (Elective-II)	03	-	-	3	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	To create appreciation and understanding the achievements of AI and the theory underlyingthose achievements
2	To create an understanding of the basic issues of knowledge representation

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
CO2	Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
CO3	To create an understanding of the basic issues of knowledge representation
CO4	Formulate and solve problems with uncertain information using Bayesian approaches.
CO5	Attain the capability to represent various real life problem domains using logic based techniques and

Syllabus –Introduction To Artificial Intelligence (Elective II), 6th Sem, Mechanical	
Contents	No of hours
UNIT-I Introduction: What is AI? History & Applications, Artificial intelligence as representation & Search, Production system, Basics of problem solving: problem representation paradigms, defining problem as a state space representation, Characteristics.	06
Unit II : Search Techniques: Uninformed Search techniques, Informed Heuristic Based Search, Generate and test, Hill-climbing, Best-First Search, Problem Reduction, and Constraint Satisfaction.	07
Unit III: Knowledge representation: Knowledge representation Issues: First order logic, Predicate Logic, Structured Knowledge Representation: Backward Chaining, Backward Chaining, Resolution,Semantic Nets, Frames, and Scripts, Ontology.	08
Unit IV: Uncertainty: Handing uncertain knowledge, rational decisions, basics of probability, axioms of probability, Baye's Rule and conditional independence, Bayesian networks, Exact and Approximate inference in Bayesian Networks, Fuzzy Logic.Intelligent Agents: Introduction to Intelligent Agents, Rational Agent, their structure, reflex, model-based, goal-based, and utility-based agents, behavior and environment in which a particular agent operates,	08
Unit V Learning: What is learning?, Knowledge and learning, Learning in Problem Solving, Learning from example, learning probabilistic models Expert Systems: Fundamental blocks, Knowledge Engineering, Knowledge Acquisition, Knowledge Based Systems, Basic understanding of Natural language	07

References:

Text Books Recommended:

1. E.Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, 2008.
2. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd edition, PearsonEducation, 2015.
3. Artificial intelligence and soft computing for beginners by Anandita Das Bhattachargee, ShroffPublishers
4. Artificial Intelligence – A Practical Approach : Patterson , Tata McGraw Hill, 3rd Edition

Reference Books Recommended:

1. Introduction to Artificial Intelligence – Charniak (Pearson Education) publication.

RTM Nagpur University- Mechanical Engineering
B.Tech 6th SEM-(Open Elective –I)
Entrepreneurship Development -BTME606T
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	Entrepreneurship Development (Open Elective –I)	3	-	-	3	30	70	100	03

Sr. No.	Course Objective The objective of this course are–
1	To develop a knowledge on basic concepts of entrepreneurship.
2	To develop a knowledge on affecting parameters of entrepreneurship and it policies.
3	To create a knowledge on preparation of entrepreneurship methodology
4	To get a knowledge on applications of entrepreneurship
5	To know about effective management of entrepreneurship in small scale Industries.
	Course Outcomes
After successful completion of this course the student will be able to:	
CO1	**Apply** the knowledge of entrepreneurship qualities and skills to startup a business
CO2	**Apply** the knowledge of entrepreneurship policies to startup a business
CO3	**Prepare** a feasibility report and evaluation criteria for an entrepreneurship
CO4	**Analyze** marketing strategies of entrepreneurship
CO5	**Apply** preventive measures to be followed for effective management of Entrepreneurship.

Syllabus –Entrepreneurship Development (Open Elective I), 6th Sem, Mechanical	
Contents	No of hours
Unit-I ENTREPRENEURAL COMPETENCE Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality -Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.	06
Unit II: ENTREPRENEURAL ENVIRONMENT Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations - International Business.	08
Unit III: BUSINESS PLAN PREPARATION Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product -Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.	08
Unit IV: LAUNCHING OF SMALL BUSINESS Finance and Human Resource Mobilization Operations Planning - Market and ChannelSelection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.	08
Unit V: MANAGEMENT OF SMALL BUSINESS Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.	07

References:

Text Books Recommended:

1. **Entrepreneurship Development-S.S.Khanka, S.Chand Publication**
2. **Entrepreneurship Development-Dr.C.B.Gupta, Dr.N.P.Shrinivasan, S.Chand Publication**
3. **Entrepreneurship Development-S Anil Kumar, S.C Poornima, Mini k Abraham, K Jayashree,New Age International Publication**

Reference Books Recommended:

1. **Entrepreneurship Development- Sharma,Sangeeta,PHI Learning Pvt. Ltd, 2nd Edition**

2. **Entrepreneurship Development- Sanjay R Ajmeri, Lulu Press Incorporated**

RTM Nagpur University- Mechanical Engineering
B.Tech 6th SEM-(Open Elective –I)
Automobile Engineering -BTME606T
Syllabus (Theory)

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

Sr. No.	Course Objective
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 Sucessful Completion of the Course Students 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.

Contents	No of hours
Unit I Introduction: Classification of automobiles, Major components and their functions. Chassis. Engine Power Plant: Constructional features of different types of engines used in automobiles. SI and CI Engine, Four stroke and Two stroke engine. Fuel supply systems, cooling systems, lubrication systems.	7 hrs
Unit II Transmission system: Clutch: Necessity, requirements of a clutch system. Types of Clutches, centrifugal clutch, single and multi-plate clutch, fluid clutch. Gear Box: Necessity of transmission, principle, types of transmission, sliding mesh, constant mesh, synchromesh, transfer gear box, gear selector mechanism. Semiautomatic and automatic transmission. Propeller shaft, universal joint, Hotchkiss drive, torque tube drive. Differential, Rear axles and Front axles.	8hrs
Unit III Steering systems: Principle of steering, steering geometry and wheel alignment, Power Steering. Under steer, Over-steer. Suspension systems: Need, conventional suspension, Independent suspension System, Active suspensions. Brakes: Function, Classification, Basic Components. Drum Brakes, Disc Brakes, Hydraulic brakes, Air Brakes, ABS.	8 hrs
Unit IV Electrical Systems: Battery, magneto and electronic ignition systems, Automobile air-conditioning. Automotive lighting circuit. 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.	7hrs
Unit V Electric vehicles, components of EV, EV Batteries, EV Chargers. Hybrid vehicles. Vehicle Pollution Control: cause and types of Emissions from Vehicle, Euro and Bharat Stage norms. 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, navigational aids, Automatic Cruise Control and Parking Assistance system.	8hrs

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
B.Tech 6th SEM-(Open Elective –I)
Project Evaluation & Management -BTME606T
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 Semester Mechanical	Project Evaluation & Management	3	-	-	3	30	70	100	03

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.

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	Estimate network scheduling and network planning
CO4	Manage lifecycle on the various phases from project initiation through closure.
CO5	Estimate project Costs, Earned Value Analysis, Monitoring Project Progress, and Project Appraisal.

SYLLABUS	
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.	09
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, and Raw Material & Utility Availability. Financial: Cost of Project, Means of Finance, Financial Projections	09
Unit III Project Planning- Development of Project Network; Project Representation; Consistency and Redundancy in Project Networks; Project Scheduling- Basic Scheduling 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.	09
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.	09
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.	09

References:

Text Books Recommended:

1.Narendra Singh; Project Management & Control; Himalaya Publishing House, Mumbai

2 S. Chaudhary, 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
B.Tech. 6th Semester
Open Elective – I: Operation Research Techniques (BTME606T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Operation Research Techniques	3	-	-	3	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	To study the different OR tools.
2	Study to apply appropriate model to a 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	Formulate and obtain the optimal solution for Linear Programming problems.
CO2	Identify, formulate and obtain optimal solution using transportation and assignment model
CO3	Formulate Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems
CO4	Optimize the problem using Queuing model and Inventory model.
CO5	Optimally arrange the machine/job in a sequence and also simulate the real life problem.

SYLLABUS	
Contents	No of hours
Unit I Introduction to O.R. & basic O.R. Models, Characteristics, phases & Methodology of O.R., Limitations & Applications. Linear Programming: Introduction, Linear programming problem formulation, LPP Solution by Graphical Method, Simplex Method.	07
Unit II Transportation Model: Formulation, Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's Approximation Method), Optimality method, Unbalanced Transportation Problem. Assignment Model: Formulation, unbalanced assignment problem, Variants of Assignment Problems.	08
Unit III Network Model: Drawing of Network, CPM & PERT, probability of completion of project, Cost Analysis of Project, and Concept of Crashing. Allocation & updating of Network.	07
Unit IV Queuing models: Poisson arrivals and Exponential service times – Single channel models (MM1) and Multi channel models. (No derivation expected) Inventory Control Model: Introduction and inventory management concepts, Economic Order Quantity model (EOQ), Economic Production Quantity model (EPQ), model for purchase allowing for shortages, ABC analysis.	08
Unit V Sequencing Model: Introduction, 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.	08

References:

Text Books Recommended:

1. Operation Research, Heera & Gupta, S Chand Publications.
2. Operation Research, J. K. Sharma, Macmilan Publishers.

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

B.Tech. 6th Semester

Open Elective – I: Industrial Safety & Environment (BTME606T)

Proposed Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessm	University Exami	Total	
VI	Industrial Safety & Environment	3	-	-	3	30	70	100	3 Hrs

Sr. No.	Course Objective The objective of this course is–
1	To learn about basic fundamentals of industrial safety and its importance for protecting an environment against damages from industrial accidents.
2	To gain an understanding of management responsibilities and the legal aspects of industrial safety.
3	To acquire the knowledge of safe working practices & emergency preparedness in industrial framework.
4	To minimize financial losses, property damage and human safety in industrial environment by applying principles of industrial safety.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Gain the knowledge about industrial safety protocols and its different dimensions.
CO2	Know about an administrative angle ofthe industrial safety.
CO3	Understand the legal aspects of the safety.
CO4	Acknowledge the safe working practices.
CO5	Be aware of emergency preparedness in work environment.

SYLLABUS	
Contents	No of hours
Unit I –Safety, Health and Environment - Safety, Health and Environment Policy - Fundamental of Safety - General Instruction - Accident CausesIdentification - Hazards Identification (Fire, Chemical, Mechanical, Electrical, Radiation, Environmental) - Safe Engineering Designs	8
Unit II–Organization, Administration and Management responsibility - Objective - Basic Safety Programme - Safety Department - Responsibilities of Top Management, Middle Management & Workers - Responsibilities of Government&Public Authorities - Responsibilities of Social Organizations	7
Unit III - Legal aspect of the Safety - The Factories Act 1948 - The Maharashtra Factories Rules 1963 - The Dangerous Machines (Regulation Act) 1983 - The Dangerous Machines (Regulation Rules) 2007 - The Maharashtra Factories (Control of Industrial Major Accident Hazards) Rules 2003 - The Maharashtra Factories (Safety Audits) Rules 2014	8

Unit IV – Safe working practices - Housekeeping - Safety Manual - Occupational Health and Safety Policy - Standards Operating Procedures (SOPs) - Work Permit Systems - Medical Management of Accident - Safety Trainings - Personnel Protection Equipment (PPEs)	8
Unit V –Emergency preparedness - Site Specific Details - Duties and Responsibilities of Key Personnel - Identification of Emergencies and Accident Scenario - Declaration and Termination of Emergency - Resources-evacuation / Transport - Communication Facilities - Medical Care - Periodic Drills / Exercises - Public Awareness Programmers - Emergency Control Centre Duties	8

References:

Text Books Recommended:

1.Industrial Safety, Health and Environment Management Systems by R.K. Jain and Prof. Sunil S. Rao, Khanna Publishers.

2. Industrial Safety and Environment by Amit Gupta, Laxmi Publications (P) Ltd.

3. Industrial Safety and Maintenance Management by M. P. Poonia and S. C. Sharma, Khanna Book Publishing Co. (P) Ltd.

Reference Books Recommended:

1. Safety & Health for Engineers- Roger. L. Brauer, John Wiley Sons 2006

2.Accident Prevention Manual for Industrial Operation , N.S.C Chicago 1982

3.Publication from International Standard Organization like ISO, OSHA, NEBOSH

4. Gerad Kiely, Environmental Engineering, McGraw Hill Education (India) Private Limited

RTM Nagpur University- Mechanical Engineering
B.Tech 6th Semester (Mandatory Course)
Environment Science (BTME607T)
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	Environment Science	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:

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