Shivaji University, Kolhapur.

STRUCTURE & SYLLABUS FOR B. E. (PRODUCTION ENGINEERING) PROGRAM

Class: S. E. (PRODUCTION ENGINEERING) SEMESTER-III
(TO BE REVISED FROM JULY 2014)

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Machine Tools and Processes	3	1	-	4	3	100	25	-	25	150
2	Engineering Mathematics – III	3	-	1*	4	3	100	25	-	-	125
3	Machine Drawing	2	4	-	6	4	100	25	-	25	150
4	Thermal Engineering	3	2	-	5	3	100	25	-	-	125
5	Electrical and Electronics Engineering	3	2	-	5	3	100	25	-	-	125
6	Object Oriented Programming with C++	2	2	-	4	-	-	25	50	-	75
7	Workshop Practice-III	-	2	-	2	-	-	50	-	-	50
	Total	16	13	1	30	-	500	200	50	50	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work, * Tutorials shall be conducted batch-wise.

Class: S. E. (PRODUCTION ENGINEERING) SEMESTER-IV

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Foundry Technology	3	2	-	5	3	100	25	-	-	125
2	Advanced Machine Tools and Processes	3	1	-	4	3	100	25	-	-	125
3	Theory of Machines-I	3	2	-	5	4	100	25	-	-	125
4	Analysis of Machine Elements	3	2	-	5	3	100	25	-	25	150
5	Welding Technology	3	2	-	5	3	100	25	-	-	125
6	Computer Aided Solid Modelling	1	2	-	3	-	-	25	25	-	50
7	WS Practice-IV	-	2	-	2	-	-	25	25		50
8	Mini Project*	-	1	-	1	-	-	50	-	-	50
	Total	16	14	-	30	-	500	225	50	25	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work,

* Note: For Mini Project, a group of nine students shall be considered for workload purpose.

Shivaji University, Kolhapur.
Class: T. E. (PRODUCTION ENGINEERING) SEMESTER-V

(TO BE REVISED FROM JULY 2015)

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Metallurgy	3	2	-	5	3	100	25	-	-	125
2	Theory of Machines-II	3	2	-	5	3	100	25	-	-	125
3	Design of Machine Elements	3	2	-	5	3	100	25	-	-	125
4	Metrology	3	2	-	5	3	100	25	25	-	150
5	Metal Forming and Plastic Engineering	3	1	-	4	3	100	25	-	-	125
6	Metal Cutting Theory	3	1	-	4	3	100	25	-	-	125
7	WS Practice -V*	-	2	-	2	-	-	25	-	-	25
	Total	18	12	-	30	-	600	175	25	-	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work
*Note: Work load of 2 Hrs. practical per batch to be allotted to the teaching faculty member.

Class: T. E. (PRODUCTION ENGINEERING) SEMESTER-VI

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Industrial Management	3	1	-	4	3	100	25	-	-	125
2	Industrial Hydraulics and Pneumatics	3	2	-	5	3	100	25	-	25	150
3	Design of Jigs, Fixtures and Dies	4	2	-	6	4	100	25	-	25	150
4	Quality Management	3	2	-	5	3	100	25	-	-	125
5	Machine Tool Design	3	2	-	5	3	100	25	-	-	125
6	CAM Laboratory and CNC Workshop Practice	-	4	-	4	-	-	50	50	-	100
7	Research Seminar #	-	1	-	1	-	-	25	-	-	25
	Total	16	14	-	30	-	500	200	50	50	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work
Note: For Research Seminar, a group of nine students shall be considered for workload purpose.
√ Please refer to the important Instructions for Industrial Training & Project Work at the end of T.E.-Prod. Sem-VI syllabus.

Shivaji University, Kolhapur.
Class: B. E. (PRODUCTION ENGINEERING) SEMESTER-VII

(TO BE REVISED FROM JULY 2016-17)

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Operations Research	3	2	-	5	3	100	25	-	-	125
2	Mechatronic Systems	3	2	-	5	3	100	25	25	-	150
3	Production and Operations Management	3	2	-	5	3	100	25	-	-	125
4	Process Engineering	4	2	-	6	4	100	25	-	25	150
5	Elective-I	3	2	-	5	3	100	25	-	-	125
6	Industrial Training*	-	-	-	-	-	-	25	-	25	50
7	Project Work * Phase-I	-	2*	-	2*	-	-	75	-	-	75
	Total	16	12	-	28	-	500	225	25	50	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work
*Note: For Industrial Training and Project Work a group of nine students shall be considered for workload purpose.

Class: B. E. (PRODUCTION ENGINEERING) SEMESTER-VIII

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Costing and Cost Control	3	2	-	5	3	100	25	-	-	125
2	Industrial Engineering	3	2	-	5	3	100	25	-	25	150
3	Finite Element Analysis	4	2	-	6	3	100	25	25	-	150
4	Elective-II	3	2	-	5	3	100	25	-	-	125
5	Elective-III	3	2	-	5	3	100	25	-	-	125
6	Project Work Phase-II #	-	4#	-	4#	-	-	75	-	50	125
	Total	16	14		30	-	500	200	25	75	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work
Note: For Project Work a group of nine students shall be considered for workload purpose.

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List of Elective Subjects for B. E. (Prod. Engg.) Sem. VII and Sem. VIII

Elective I: (Interdisciplinary Group)

1. Automobile Engineering
2. Energy Engineering
3. Composite Materials and Technology
4. Experimental Stress Analysis
5. Safety Engineering
6. Rapid Prototyping
7. Reliability Engineering

Elective II: (Design and Systems Group)

1. Product Design and Development
2. Advanced Machine Design
3. Advanced Tool & Die Design
4. Material Handling Systems
5. Artificial Intelligence
6. Industrial Robotics
7. Computer Integrated Manufacturing Systems

Elective III: (Management Group)

1. Marketing Management
2. Statistics for Engineering Research
3. Materials Management
4. Project Management
5. Financial Management
6. Entrepreneurship Development
7. Supply Chain Management

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EQUIVALENCE OF OLD & NEW SYLLABI OF S. E.(Prod. Engg.)

Old Examination	Sr. No.	Subject under Old Syllabus	New Examination	Equivalent Subject under New Syllabus
S. E. (Prod.Engg.) Sem. I	1	Engineering Mathematics-III	S. E. (Prod. Engg.)Sem. I	Engineering Mathematics-III
	2	Machine Drawing	S. E. (Prod. Engg.)Sem. I	Machine Drawing
	3	Thermal Engineering	S. E. (Prod. Engg.)Sem. I	Thermal Engineering
	4	Electrical Technology & Industrial Electronics	S. E. (Prod. Engg.)Sem. I	Electrical & Electronics Engineering
	5	Machine Tools & Processes	S. E. (Prod. Engg.)Sem. I	Machine Tools and Processes
	6	Advanced Programming Laboratory	S. E. (Prod. Engg.)Sem. I	Object Oriented Programming with C++
S. E. (Prod.Engg.) Sem. II	1	Advanced Machine Tools and Processes	S. E. (Prod. Engg.)Sem. II	Advanced Machine Tools and Processes
	2	Foundry Technology	S. E. (Prod. Engg.)Sem. II	Foundry Technology
	3	Analysis of Machine Elements	S. E. (Prod. Engg.)Sem. II	Analysis of Machine Elements
	4	Welding Technology	S. E. (Prod. Engg.)Sem. II	Welding Technology
	5	Theory of Machines - I	S. E. (Prod. Engg.)Sem. II	Theory of Machines-I
	6	Computer Aided Solid Modelling	S. E. (Prod. Engg.)Sem. II	Computer Aided Solid Modelling
	7	Work Shop Practice-IV	S. E. (Prod. Engg.)Sem. II	Work Shop Practice-IV

EQUIVALENCE OF OLD & NEW SYLLABI OF T. E.(Prod. Engg.)

Old Examination	Sr. No.	Subject under Old Syllabus	New Examination	Equivalent Subject under New Syllabus
T. E. (Prod.Engg.) Sem. I	1	Metallurgy - I	T. E. (Prod. Engg.) Sem. I	Metallurgy
	2	Theory of Machines – II	T. E. (Prod. Engg.) Sem. I	Theory of Machines-II
	3	Design of Machine Elements	T. E. (Prod. Engg.) Sem. I	Design of Machine Elements
	4	Metal Cutting Technology	T. E. (Prod. Engg.) Sem. I	Metal Cutting Theory
	5	Metal Forming & Plastics Technology	T. E. (Prod. Engg.) Sem. I	Metal Forming & Plastics Engineering
	6	Metrology	T. E. (Prod. Engg.) Sem. I	Metrology

	7	Work Shop Practice-V	----	No Equivalence, Two additional chances to be given
T. E. (Prod.Engg.) Sem. II	1	Metallurgy – II	----	No Equivalence, Two additional chances to be given
	2	Industrial Management	T. E. (Prod. Engg.)Sem. II	Industrial Management
	3	Industrial Hydraulics & Pneumatics	T. E. (Prod. Engg.) Sem. II	Industrial Hydraulics & Pneumatics
	4	Design of Jigs, Fixtures & Dies	T. E. (Prod. Engg.) Sem. II	Design of Jigs, Fixtures & Dies
	5	Quality Management	T. E. (Prod. Engg.) Sem. II	Quality Management
	6	Machine Tools & Product Design	T. E. (Prod. Engg.) Sem. II	Machine Tool Design
	7	Work Shop Practice-VI	----	No Equivalence, Two additional chances to be given
	8	Seminar	T. E. (Prod. Engg.) Sem. II	Research Seminar

EQUIVALENCE OF OLD & NEW SYLLABI OF B. E.(Prod. Engg.)

Old Examination	Sr. No.	Subject under Old Syllabus	New Examination	Equivalent Subject under New Syllabus
B. E. (Prod. Engg.) Sem. I	1	Operations Research	B. E. (Prod. Engg.) Sem. I	Operations Research
	2	Mechatronic Systems	B. E. (Prod. Engg.) Sem. I	Mechatronic Systems
	3	Process Engineering	B. E. (Prod. Engg.) Sem. I	Process Engineering
	4	Production & Operations Management	B. E. (Prod. Engg.) Sem. I	Production and Operations Management
	5	Computer Aided Design & Analysis	B. E. (Prod. Engg.) Sem. II	Finite Element Analysis
	6	Advanced CNC Laboratory	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	7	Vacational In-plant Training Report	B. E. (Prod. Engg.) Sem. II	Industrial Training
B. E. (Prod. Engg.) Sem. II	1	Costing and Cost Control	B. E. (Prod. Engg.) Sem.	Costing and Cost Control

			II	
	2	Computer Integrated Manufacturing Systems	B. E. (Prod. Engg.) Sem. II	Elective II -7. Computer Integrated Manufacturing Systems
	3	Advanced Industrial Engineering	B. E. (Prod. Engg.) Sem. II	Industrial Engineering
	4	E I- Marketing Management	B. E. (Prod. Engg.) Sem. II	E III- 1. Marketing Management
	5	E I- Entrepreneurship Development	B. E. (Prod. Engg.) Sem. II	E III-6. Entrepreneurship Development
	6	E I- Materials Management	B. E. (Prod. Engg.) Sem. II	E III- 3. Materials Management
	7	E I- Data Base Management	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	8	E I- Financial Management	B. E. (Prod. Engg.) Sem. II	E III- 5. Financial Management
	9	E I- Environment & Pollution Control	---	No Equivalence, Two additional chances to be given
	10	E I- Organizational Behaviour	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	11	E II- Flexible Manufacturing Systems	B. E. (Prod. Engg.) Sem. II	EII- 7-Computer Integrated Manufacturing Systems
	12	E II-Artificial Intelligence	B. E. (Prod. Engg.) Sem. II	E II- 5. Artificial Intelligence
	13	E II-Industrial Robotics	B. E. (Prod. Engg.) Sem. II	E II-6. Industrial Robotics
	14	E II-Low Cost Automation	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	15	E II-Material Handling Systems	B. E. (Prod. Engg.) Sem. II	E II-4. Material Handling Systems
	16	E II-Advanced Foundry Technology	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	17	E II-Advanced Tool & Die Design	B. E. (Prod. Engg.) Sem. II	E II- 3. Advanced Tool & Die Design

Shivaji University, Kolhapur.
B. E. (Production Engineering) – Part-I, Semester VII

1. OPERATIONS RESEARCH

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs./ Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr./ Week/ Batch	Term work: 25 Marks

Course Objective:
To study the quantitative techniques in management decision-making and its applications by using mathematical models.

Course Outcome:
The students shall demonstrate the knowledge

Unit1-1
Introduction to O.R and Linear Programming:
Birth of O.R., Methodology, Scope and Limitations. Types of O.R. Models, Applications in Production Management, Use of computers in O.R, Linear Programming: Formulation, graphical method**.** (5)

Unit-2

Linear Programming Problems
Simplex algorithm for maximization and minimization problems, sensitivity analysis, duality theory and its use in economic interpretation and decision making. (6)

Unit-3
Transportation and Assignment Models:
Structure, Industrial and business applications

a) Transportation problems: Use of various methods for solving transportation problems, degeneracy and its solution.
b) Assignment problems: Solution of various types of problems, Traveling Salesman problem. (7)

Unit-4
Sequencing and Replacement Analysis

a) Sequencing: Sequencing of n jobs and 2 and 3 machines, 2 jobs and m machines.
b) Replacement Analysis: With and without time value of money, single item and group replacement. (6)

Unit-5
Project Management

Fundamentals of CPM / PERT networks: CPM – construction of networks, critical path, forward and backward pass, floats & their significance, crashing for minimum cost and optimum and minimum duration, resource allocation and leveling.
PERT – Time Estimates, Construction of Networks, Probability of completing projects by given date. (8)

Unit-6

Decision Theory and Network Techniques:

a) **Decision Theory:** pay off and regret tables, decision rules, decisions under uncertainty and risk, decision tree.
b) **Network Techniques:** Shortest path model- Dijkstra's Algorithm, Floyd's Algorithm. (6)

Note: The University question paper shall include numerical treatment on all units.

Term Work:

It shall comprise of the following numerical assignments .At least two assignments must be based on Case study. Use of computers is essential for at least two assignments

1. Formulation of LPP and Graphical Solution.
2. Assignment on Maximization / Minimization of L. P. Problems.
3. Assignment on Transportation / Assignment Problems.
4. Assignment on Replacement Analysis.
5. Assignment on Sequencing Problems.
6. Assignment on CPM/PERT Problems
7. Assignment on Decision Theory.
8. Assignment on Shortest Path Models

Reference Books:

1) Introduction to O.R., 7/e (with CD) – Hamdy A. Taha, (PHI)
2) Quantitative Techniques in Management, 4/e - N.D. Vora. (TMH)
3) Introduction to O.R., 7/e (with CD) – Hillier & Lieberman (TMH)
4) Operations Research, 2/e – R. Panneerselvam (PHI)
5) Operations Research- Natarajan, A.M.; Balasubramani, P. & Tamilrasi A. (Pearson Education)
6) Operations Research – J.K. Sharma. (Mac Millan)
7) Operations Research – P. Sankara Iyer (TMH- Sigma Series, 2008)
8) Operations Research – Principles & Practice - Ravindran, Phillips & Solberg (John Wily & Sons, Wiley India, 2006)
9) Introduction to Operations Research-Theory & Applications, - H.S. Kasana & K.D. Kumar, (Springer International Edition, 2005, Springer India)
10) Operations Research- Applications & Algorithms, 4/e, - Wayne L. Winston (CENGAGE Learning 2003)

Shivaji University, Kolhapur.
B. E. (Production Engineering) Part-I, Semester VII

2. MECHATRONIC SYSTEMS

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hr. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks
Practical Examination: 25 Marks

Course Objective:

To understand working principle of necessary components required for Mechatronic Systems and their applications in system designing.

Course Objective:
The student shall demonstrate the knowledge of the working principles of necessary components required for Mechatronic Systems and their applications in system designing.

1) Control Systems: Components of Mechatronic systems, Types of Control Systems, concept of transfer function, Modes of control on/off, P, PI, PD and PID, Adaptive control system, System modeling of mechanical, electrical, fluid systems, D.C. motor and generator; Types of standard inputs (signals), Time response specifications of first and second order systems (6)

2) Sensors, Transducers and Actuators: Performance, terminology, characteristics, types, binary and analog; Contact and non-contact type switches and proximity sensors- inductive, capacitive, optical, pneumatic, potentiometric, thermal, incremental and absolute encoders, tachogenerator; Applications in position, displacement, velocity, force, torque and temperature measurement; **Actuators** – working principle and applications: Variable frequency AC drives, Pulse width modulation and cycloconvertor for controlling AC frequency, Brushless DC servomotors, timing motors, torque motors, SCR (Silicon Controlled Rectifiers) motors, Stepper motors- types, specifications and control, relays and solenoids. (10)

3) Programmable Logic Controllers (PLC) and Supervisory Control And Data Acquisition (SCADA): Structure, input/output units and input/output processing, programming, ladder diagrams, logic functions, latching, sequencing, timers, counters, jumps, analog input/output and applications, Concept of SCADA, its industrial significance and applications. (6)

4) Microcontroller: Architecture and pin diagram of 8051 controller, Programming of microcontroller, selection of microcontroller for automation applications, interfacing. (4)

5) Signal Conditioning and Interfacing: Signal conditioning processes, clock signal, voltage divider, rectification, Operational Amplifiers: inverting and non-inverting, summing, integrating, differential, logarithmic, comparator; 555 timer, sample and hold, analog to digital and digital to analog converters, multiplexing and de-multiplexing, Interfacing input output ports, serial and parallel interfacing requirements, buffers, handshaking, polling and interrupts. (6)

6) MEMS: Overview of MEMS and Microsystems, typical MEMS and Micro system products and applications. (i) Micro sensors and micro actuators: phototransistors, pressure sensors, thermal sensors, micro grippers, micro motors, micro valves, micro pumps (ii) Micro-manufacturing: bulk manufacturing, surface manufacturing, LIGA process. Case study of Mechatronic systems in manufacturing and automation. (6)

Term Work:
1. Fabrication of a simple mechatronics working project by a group of 2-3 students, (A list of some sample projects is given further. One Project shall be carried out by each of the student groups and submitted as a part of term work.).**
2. Minimum two programs and their execution on PLC for logic, timer, counter and sequencing applications involving use of sensors for position, displacement and velocity.
3. Use OPAMP KITS to perform experiments (minimum two)
4. Interfacing of stepper motor with microcontroller/PLC for position, speed and direction control
5. One Exercise involving programming of microcontroller with interfacing of sensors for simple control applications like temperature control, pressure control, position control etc.
6. Simple MATLAB/SCILAB Programming exercises for control system (minimum two).
7.One assignments on SCADA applications for simple problems.
8. Industrial visit to study Mechatronic system application and submission of visit report.

****Note:** This project exercises shall include use of PLC, microcontroller, various sensors, Analog-to-digital and Digital-to-analog conversion, simple electronic circuits etc. for Mechanical/Production Engg. applications.

The list given below is indicative only and other suitable projects may be undertaken.
List of Sample Projects: Automatic door control (Open/Close), Water level control, Automatic Belt conveyor, Soft touch bi-directional motor control, Temperature sensor with analogue to digital output, Overheat control using heat sensor to operate cooling fan, Automatic railway gate control, Clap operated relays, Piece counters etc.

Note for Practical Examination: A batch of not more than two students shall perform any one exercise from 2, 3, 4 and 5 of above-mentioned list and show the results. This will be followed by oral examination.

Reference Books:

1. Ogata – Modern Control Engineering (Pearson Education) ISBN 81-7808-579-8
2. Industrial Automation – David. W. Pessen (John Wiley & Sons) ISBN 9971- 51-054-5.
3. Automated Manufacturing Systems: Sensors, Actuators – S. Brain Morriss (McGraw Hill) ISBN 0-07-113999-0
4. Mechatronics 3/e - W. Bolton (Addison Wesley) ISBN 81-7758-284-4
5. Introduction to Mechatronics & Measurement System – David G. Alciatore & Michael B. Histand (TMH) ISBN 0-07-052908.
6. Mechatronics Principles, Concepts & Applications – N.P.Mahalik (TMH) ISBN 0-07- 0483744
7. Mechatronics – Dan Necsulescu (Pearson Education) ISBN 81-7808 -676 – X.
8. The 8051 Microcontroller: Architecture, Programming & Applications, 2/e – Kenneth J. Ayala (Penram International) ISBN – 81-900828-7
9. Computer Control of Manufacturing systems-Yoram Koren (McGraw Hill) ISBN 0-07-066379-3
10. MEMS & Microsystems Design & Manufacture – Tai – Ran Hsu – TMH 0-07-048709.
11. MEMS – Mahalik, N.P. (TMH) ISBN :13 978-0-07-063445-9
12. CAD/CAM –Concepts & Applications, Channakesava R. Alavala (PHI)
13. Mechatronics, Singh, M.D,. & Joshi J.G. (EEE) (PHI) (2006- ISBN 81-203-2986-4.
14. Practical SCADA for industry, David Bailey, (Elsevier Publi.) ISBN 0-7506-5805-3.

Shivaji University, Kolhapur.
B. E. (Production Engineering) -Part-I, Semester VII

3. PRODUCTION AND OPERATIONS MANAGEMENT

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objective:
To study the concepts of Production and Operations Management and their applications.

Course Outcome:
The students shall demonstrate the knowledge of the concepts of Production and Operations Management and their applications.

Unit -1

1. Introduction: definition, importance, relative position in organization, functions of production management, types of production and their characteristics, continuous and intermittent.

a) Pre-production functions:

i) Product design and development: marketing, functional, manufacturing and economical aspects, 3 'S' - simplification, standardization, specialization.

ii) Sales forecasting: use of forecast, types, accuracy, statistical forecasting, types of demands, various types of forecasting methods, verifying and controlling the forecast.

iii) Capacity and Aggregate Planning: Definition, Measure of Capacity, capacity strategies Estimation of number of machines, Overcapacity and under capacity factors,

Aggregate Planning- Strategies, Pure and mixed strategies, Use of transportation model approach to aggregate planning, requirement of personnel, make or buy decision, line balancing, (8)

Unit - 2

a) Production Planning:

Production functions- routing, scheduling, machine loading, intermittent and continuous routing -Process charts, job cards, route cards, operation charts, Scheduling: definition, need and objectives, factors affecting, Loading: machine loading, techniques. Drum-buffer-rope concept: Production scheduling application in Theory of Constraints

b) Production Control: Definition, dispatching, progressing, coordination, Dispatching: job orders and issue systems, dispatching rules. Progressing: follow up, feedback, corrective actions. Coordination: relationship of PPC department with other departments, coordinating with other departments for planning and execution. (5)

Unit - 3

a) Introduction to Modern Production/Operation Management Techniques: Toyota Production System, Five 'S', Lean manufacturing, Poka Yoke, Kaizen, SMED, Introduction to Six Sigma concept and methodology. (6)

Unit - 4

Inventory Management:

a) Aims, buffer stocks, lead time, ROL, fixed order quantity system, periodic review system, Selective Inventory Control Techniques - ABC and VED analysis, JIT manufacturing /purchasing,

b) Inventory Models: Various costs involved, classification of models, EOQ model with and without shortage, EOQ with uniform demand and production lot size model, EOQ model with single price break.

c) Stores Management: objectives, functions, procedure, documentation, stock taking and reconciliation (8)

Unit - 5

a) Supply Chain Management: Definition, decision phases in supply chain, process view of supply chain, importance.

b) Logistics Management: Meaning, scope and elements of logistics, need for logistics Engineering (5)

Unit - 6

a) Maintenance: Types, break down, preventive and predictive (condition based maintenance), selection of maintenance strategy, Total Productive Maintenance –Concept, Calculations of OEE.

b) Safety and Disaster Management: Reasons, analysis and prevention in manufacturing establishments.

c) Human Consideration in Production Management: Industrial Psychology – Introduction, motivational factors, behavioral aspects, grievances, working conditions, safety; shop supervisor's role in above functions. (6)

Note: The University question paper shall include numerical treatment on all six units.

Term Work:
It shall comprise of the following assignments. The assignments shall be different for each group of about 3-4 students each. At least two assignments must be based on Case study. Use of computers is essential for at least two assignments.

1) A Case study on Pre – production functions
2) Exercise on Production planning/scheduling of batch production of about 5 – 10 variety of parts for given batch sizes with preparation of Gantt's Chart
3) A case study on production control and production status reporting
4) A case study on rejection analysis on shop floor
5) Exercise on formulation of maintenance strategy in manufacturing industry
6) A case study on Supply Chain Management in manufacturing industry
7) A case study on logistic management in manufacturing industry
8) Industrial visit to study various Production/Operations management techniques and preparation of report

Reference Books:

1) Production Planning & Control – Samuel.Eilon (Universal)
2) Production Systems – James L. Riggs (Wiley)
3) Production Management – Lockyer (ELBS)
4) Production Handbook – Carson, Boltz & Young (Ronald Press)
5) Production Management – R. Mayer (McGraw Hill)
6) Operations Management: Strategy & Analysis, 6/e – Krajewsky, Ritzman (Pearson Education)
7) Modern Production Management – E.S. Buffa (John Wiley)
8) Production Management – Burbridge (ELBS)
9) Operation Management – Schroeder (McGraw Hill)
10) Stores Management – K.S. Menon (Mac Millan)
11) Just In Time Manufacturing – Korgaonkar (Mac Millan)
12) Supply Chain Management; Strategy, Planning & Operation – Sunil Chopra, Peter Meindl (Pearson Education Asia)
13) Logistics Engineering & Management – Bejamin S. Blanchard (Pearson Education Asia)
14) Total Quality Management - R S Naagarazan, A A Arivalagar. Publisher-New Age International
15) Stein, R. E., (1996) Re-engineering the manufacturing system: applying the theory of constraints (TOC). Marcel Dekker.
16) Operations Management – B. Mahadevan, (Pearson Education)
17) Operations Management- Haizer & Render, (Pearson Education)

Shivaji University, Kolhapur.
B. E. (Production Engineering) – Part-I, Semester VII

4. PROCESS ENGINEERING

Teaching Scheme:
Lectures: 4 Hrs. / Week
Practical: 2 Hr. / Week/ Batch

Examination Scheme:
Theory Paper (4 Hrs): 100 Marks
Term work: 25 Marks
Oral Exam: 25 Marks.

Course Objective:
To understand the fundamentals of process engineering in a manufacturing industry.

Course Outcome:
The students shall demonstrate the knowledge of the fundamentals of process engineering in a manufacturing industry.

Unit-1
Introduction: Process planning function and activities-drawing interpretation, material evaluation and process selection, selection of machines and tooling, setting process parameters, work-holding devices, selecting quality assurance methods, costing and documentation, Inputs and outputs for process planning, Position of product and process engineering department in the organisation, functions of product and process engineers. (7)

Unit-2
2.1 Part Print Interpretation: Indentifying Originating process, major and minor operations, identifying useful supplementary information, material specification and treatments, interchangeability and standardization, screw thread forms, tool references, dimensional and geometrical tolerances, surface finish, identifying critical processing factors (5)

2.2 Study of Machining Accuracies: Factors affecting accuracies, work piece control theories, product tolerances, process tolerances, tolerance stack -types and effects. (6)

Unit-3
3.1 Technical Feasibility Study: Raw material, basic originating process, accuracy level, processes required, machine tools and accessories required Manufacturing feasibility study with illustrations (3)
3.2 Selection of Process: General guidelines for and factors in process selection, process selection method, process and operation sequencing – guidelines; Combining and eliminating operations, economic aspects of processing (A case should be discussed), Introduction to computer aided process planning-Generative and Retrival type. (7)

Unit-4
4.1 Selection of Equipment: Various sources of information, technical, economical and managerial considerations, selection criteria for GPMs, SPMs and CNCs for processing in job, batch and mass mode. (3)
4.2 Selection of Tooling: Technical specifications of standard cutting tools and gauges required for various machining operations, selection criteria for cutting tools and gauges, study of special tools, gauges and work holding devices, selection of machining parameters. (5)

Unit-5
5. Process Planning: Preparation of process sheet for machining of a component for job, batch and mass production using conventional and CNC machines, Selection of quality assurance method and tools, in-process gauging. Process Picture sheet including process symbols. Process sheet design. (8)

Unit-6
Time Estimation: Calculation of standard time and production rates for various operations by consideration of various allowances.(Numerical exercises expected) Takt-time concept. (4)

Term Work:
1) Part print interpretation of one industrial component drawing
2) Study of formats of Process sheets, Process pictures and PPAP documents.
3) Process design of one component (made from casting, forging, bar stock, etc.) on conventional and

CNC machine tools for batch production
4) Process design of one component for mass production using SPMs considering combination of operations for achieving targeted cycle time on each SPM.
5) Time estimation for processing a component on conventional and CNC machine tools for batch production (one exercise each)
6) Industrial visit to study process designing and its report. During process design, use of cutting tool manufacturers' catalogues is essential.

Note for paper setters:
The pattern of question paper shall be as given bellow:
Q.1 Process Planning for a given component drawing (35 Marks) Compulsory question.
Q.2. Theoretical / Descriptive questions based on Syllabus with internal options (15 Marks)
Q.3 Process Planning for a given component on CNC Lathe or Machining Centre (VMC/HMC) (18 Marks) Compulsory question.
Q4. Numerical exercise on time estimation of one operation setup (12 Marks) Compulsory question.
Q.5 and 6 Theoretical / Descriptive questions based on Syllabus with internal options (15 Marks)

Reference Books:
1) Process Engineering for Manufacturing – Eary & Johnson (Prentice Hall)
2) Process Planning: The Design/Manufacturing Interface, –Petert Scallan, (2003), (Buttreworth Heinmann, Elsevier) ISBN: 0-7506-51-29-6
3) A Text Book of Production Engg, –P.C. Sharma, (Millennium Edition, 2000) S. Chand & Co.
4) Principles of Machine Tools- Sen, Bhattacharya
5) Automation, Production Systems, and C.I.M. – Groover, M.P. 3/e, (PHI)
6) Workshop Technology Vol. III – Chapman (ELBS)
7) Manufacturing Technology: Principles for Optimisation – Daniel
8) Mechanical Estimating and Costing – TTTI Chennai (TMH)
9) Standard manuals of ISO, QS, TS etc.
10) Manufacturers' catalogues for cutting tools and inspection equipments
11) Product Design-Kevin Otto and Kristin Wood (Pearson)
12) All About Machine Tools-Heinrich Gerling (New Age International)
13) Westerman Tables (Metals) (New Age International)

Shivaji University, Kolhapur.
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ELECTIVE – I: 1. AUTOMOBILE ENGINEERING

Teaching scheme:	**Examination scheme:**
Lectures: 3 Hrs/week	Theory Paper (3 Hrs.): 100 Marks
Practicals: 2 Hrs/ week	Term work: 25 Marks

Course Objective:
To study the fundamentals, types, construction and working principles of automobiles and its parts & systems.

Course Outcome:
The students shall have the knowledge of the fundamentals, types, construction and working principles of automobiles and its parts & systems.

Unit-1:

Introduction to Automobiles:

Classification of Automobiles, Major Components and their functions, Vehicle Specifications, Types of vehicle drive layouts for four wheelers, Drive layouts for two and three wheelers, Types of automobile bodies, Body construction and different materials for modern automobiles, Articulated vehicles, Selection of engines for different automobiles based on different criteria. Fuel cells, Electric vehicles, Hybrid Vehicles, Advantages and Limitations.

Fuel Supply Systems for SI Engines: Carburetion, air fuel requirements for SI engines under various operating conditions, essential parts of a modern carburetor, different circuits, carburetors used on automobiles, fuel injection in SI engines.

Fuel Supply Systems for CI Engines: Functional requirements of an injection system, typical arrangement of solid injection system, individual pump and; nozzle system, unit injectors, distributor system, fuel injectors, types of nozzles.

Ignition Systems: Battery ignition system, magneto ignition system, electronic ignition systems, waste spark ignition system. Different starting systems used in automobiles. (10)

Unit-2:

Study of Clutches and Gear Boxes:

a) Clutches: Types of clutches, single plate, multiplate, centrifugal clutches, clutch operating systems, wet clutches, fluid coupling, clutch plate materials. (3)

b) Gear Boxes: Functions of gear box, various resistances to motion, rolling, air and gradient resistance, total resistance and tractive effort, variation of tractive effort with speed, power required for acceleration and gradiability, selection of gear ratio, sliding mesh, constant mesh and epicyclic gear boxes, synchromesh devices, automatic gear boxes, torque converters, overdrive, propeller shaft. (5)

Unit-3

Control Systems of Automobiles:

a) Steering System:

Functions of steering system, Steering system layout, Types of automotive steering mechanisms, Types of steering gear boxes, Steering geometry-Camber, Caster, King pin inclination, included angle, Toe-in and Toe-out, Wheel alignment, Slip angle, Condition of under steer & over steer, Types and working of power steering. (5)

b) Braking System:

Requirements and functions of automotive braking system, Types of braking mechanisms Internal expanding brakes, Disc brakes, Hydraulic& Air brake systems, Servo and power brakes, Anti lock and antiskid braking, Calculation of braking force required, stopping distance and dynamic weight transfer (Numerical) (5)

Unit- 4

Study of Suspension Systems:

Objects of suspension, principles of suspension design, spring and unspring mass, types of springs, variable rate springs, torsion bars, rubber springs, shock absorbers, independent suspension, air suspension, interconnected suspension, hydro pneumatic suspension, self leveling suspension. (3)

Unit- 5

Electrical and Electronics Systems of Automobiles:

Automotive batteries, Lighting system. Starting system, Charging system, Voltage and current regulator, Electric horns and types, Dash board gauges, Wiper & side indicator Circuits, Engine electronic control modules, Microprocessors, Sensors, Safety devices, Recent developments in automobile electronics systems. (4)

Unit- 6

Automobile Maintenance: Preventive maintenance, troubleshooting and diagnosis for the systems that constitute a automobile. (2)

Term Work:

Minimum eight experiments from Group A and all experiments from Group B shall be performed

Group A:

1. Study and demonstration of four wheeler chassis layout. Two-wheel & four-wheel drive layouts.
2. Study and Demonstration of working of single plate automobile clutch.
3. Study and demonstration of synchromesh gearbox.
4. Study and demonstration of final drive and differential.
5. Study and demonstration of working Hydraulic braking system.
6. Study and demonstration of front wheel steering geometry and steering mechanism.
7. Study and demonstration of suspension system of a four-wheeler.
8. Study and demonstration of electrical charging system of automobiles.
9. Study and demonstration of electrical starting system of automobiles.
10. Study and demonstration of electric horn, fuel gauge and wiper circuit of automobiles

Group B:

1. Experiment on wheel balancing & front wheel alignment.
2. Visit to servicing station for study of vehicle maintenance, repairs and report.

Reference Books:

1) W. H. Crouse, "Automotive mechanics", Tata McGraw Hill Publishing Company Ltd, New Delhi, Ninth Edition, Delhi, 1993. ,ISBN0070634351
2) Kirpal Singh, "Automobile Engineering",Vol. II,Standard Publishres Distributors,(2009), ,ISBN8180141241
3) Narang G. B. S., "Automobile Engineering", S. Chand and Company Ltd, Fifth Edition, Delhi, 1995. Motor Vehicle: Newton & Steeds
4) Newton, Steeds and Garrett. "Motor Vehicle", The English Language Book Society, Ninth Edition, 1972.
5) Heitner Joseph, "Automotive Mechanics" CBS Publishers and Distribution, Second Edition, Delhi, 1987.
6) Automobile Mechanics: N. K. Giri
7) Automobile Engineering; R. K. Rajput
8) Automobile Engineering: K.K.Ramalingam
9) Automobile Electrical Equipment; P. L. Kohali
10) P. L. Ballaney, "Internal Combustion Engines", Khanna Publishers, Third Edition, New Delhi, 1991.
11) P. W. Gill, J. H. Smith, et.al, "Fundamental of I.C. Engines", Oxford and IBH Publishing Co. Pvt. Ltd., (2007) ,ISBN8120417100
12) Arkhangelsky V. et.al., "Motor Vehicle Engines", MIR Publishers, Mascow1976.

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B.E. (PRODUCTION) Part-1, Semester VII

ELECTIVE-I: 2. ENERGY ENGINEERING

Teaching Scheme :
Lecturers: 3 Hrs/ Week
Practicals: 2 Hr. / Alternate Week

Examination Scheme :
Theory Paper (3 Hrs.): 100 Marks
Term work: 25 Marks

Course Objective:
To understand the fundamentals of energy engineering and its applications.

Course Outcome:
The students shall demonstrate the knowledge of the fundamentals of energy engineering and its applications.

Unit-1.
Introduction:
Fossil fuel based systems, Impact of fossil fuel based systems, World scenario of Energy Resources, Indian Scenario of Energy Resources now and Renewable energy – sources and features, Distributed and dispersed energy system. (3)

Unit-2.
A) Solar Thermal System:
Solar potential, Solar radiation spectrum, Solar radiation geometry, Solar radiation data, Radiation measurement, Technologies of thermal energy collection, Applications of Solar Energy, Photovoltaic cell concepts, Operating Principle, Photo-cell materials, Cell module array, Applications. (5)
B) Fuel Cells:
Introduction, Principle and operation of fuel cells, classification and types of fuel. Fuel for fuel cells, performance characteristics of fuel cells, application of fuel cells. (4)
C) Wind Energy:
Wind parameters and wind data, Power from wind, Site selection, Construction and working of typical wind mill, characteristics of wind generators, Design considerations for wind mills, Operation and maintenance of wind mills, present status. Introduction to Ocean energy, Tidal energy, Geothermal Energy, Hybrid Systems. (5)

D) Biomass:
Introduction, Anaerobic digester, Biomass gasification, Pyrolysis, various applications of Biomass energy, Bio-fuel – Relevance, types, and applications. (3)

Unit-3
Energy Auditing
Need for energy audit, Types of energy audits, components of energy audit, energy audit methodology, analysis and recommendations of energy audit—examples of different applications, introduction to energy audit software. (7)

Unit-4.
Energy Economics
Determination of cost of steam, natural gas, compressed air and electricity. Financial analysis techniques - simple payback, Time value of money, Net present value (NPV),Return on investment (ROI),Internal rate of return (IRR), Risk and sensitivity analysis. (6)

Unit-5.

Electrical Energy Management

Electricity billing, Power factor improvement, and its benefit, Electricity act 2003, Lamp types and their features, recommended illumination levels, lighting system energy efficiency. (3)

Unit-6.

A) Cogeneration and Waste heat recovery

Cogeneration— Need, applications, advantages, classification, Commercial WHR devices, saving potential. (2)

B) CDM projects and carbon credit calculations

Introduction to CDM projects, carbon credits and its calculation, carbon foot print. (2)

Term Work:

The term shall consist of performing any Six of the following experiments.

1) Demonstration and measurement of Solar radiation.
2) Test and Trial on Solar flat plate collector.
3) Performance evaluation of PV cell.
4) Energy Audit – Case Study of an organization.
5) Visit to Wind Power plant.
6) Study and demonstration of fuel cell, application.
7) Visit to Biodiesel plant.

Reference Books:

1) Solar Energy by Dr. S.P. Sukhatme Tata McGraw Hill.
2) Non Conventional Energy Sources by G.D. Rai.- Khanna Publishers.
3) Energy Technology by S. Rao, Dr. B.B. Parulekar Khanna Publishers.
4) Energy Engineering by R.S. Kulkarni & Dr. S.V. Karmare.
5) Non Conventional Energy Sources by Dr. L. Umanand.
6) Introduction to Non Conventional Energy Resources by Raja, SciTech Publications

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B.E. – (Production Engineering) –Part-1, Semester VII

Elective – I : 3. COMPOSITE MATERIALS AND TECHNOLOGY

Teaching scheme	**Examination scheme:**
Lectures: 3 Hrs per Week	Theory Paper: (3 Hrs) - 100 Marks
Practical: 2 Hrs per week per batch	Term Work: 25 Marks

Course Objectives:

1) To introduce students the field of Composite Materials used in various engineering applications
2) To understand use and Fabrication of polymer matrix and Ceramic matrix composites
3) To study various Structural Composites
4) To study various Composite materials for optical and magnetic applications.

Course Outcomes:

1) Students will able to introduce the field of Composite Materials used in various engineering

applications

2) Students will able to understand use and Fabrication of polymer matrix and Ceramic matrix composites
3) Students will able to study various Structural Composites
4) Students will able to study various Composite materials for optical and magnetic applications.

Unit -1

Composite materials in engineering, reinforcing materials: fibers, whiskers and particles. Fiber materials for composites, Fibers of glass, boron, carbon, organic, ceramic and metallic fibers, Matrix materials, Interfaces between matrix and fibers and other dispersed phases. (6)

Unit -2

Polymer matrix composites, Characteristics and applications, Fabrication of polymer matrix composites, Metal matrix composites (MMC), Fabrication of MMCs by liquid state, solid state methods, powder metallurgy route and in site fabrication methods, Discontinuous reinforcement of MMCs, Ceramic matrix composites, Fabrication methods and applications. (6)

Unit -3

Mechanical properties in composites, large particle composites and the rule of mixtures for elastic constants, Mechanical properties of fiber reinforced composites, Effect of fiber length, Critical fiber length, Strength of continuous and aligned fiber composites, Discontinuous and aligned fiber composites, Toughening Mechanism, Impact Resistance, Fatigue and Environmental Effects. (6)

Unit -4

Structural Composites: Cement matrix composites, Steel Reinforced Concrete, Pre- stressed concrete, Thermal Control, Vibration reduction. Polymer matrix composites- vibration damping.(6)

Unit -5

Composite materials for Electrical, Electromagnetic and Dielectric applications, Microelectronics and Resistance heating, Electrical insulation, capacitors, piezoelectric, ferroelectric functions, electromagnetic windows, solid electrolytes, microwave switching. (6)

Unit -6

Composite materials for optical and magnetic applications, optical waveguide, optical filters and lasers, multilayer for magnetic applications. (6)

Term Work:

The term work shall consist of the following.

1) Assignment on study and application of engineering composites.
2) Assignment on study of Metal matrix composites.
3) Assignment on study of Mechanical properties of fiber reinforced composites.
4) Assignment on study of Structural Composite materials.
5) Assignment on study of Composite materials for Electrical, Electromagnetic and Dielectric applications.
6) Assignment on study of Composite materials for optical and magnetic applications.

Text Books:

1) Principles of Materials Science and Engineering, William F. Smith, Third Edition, 2002, McGraw-Hill

2) Composite Materials: Engineering and Science, Matthews F.L., and Rawlings R. D., 1999, Woodhead Publishing Limited, Cambridge England.
3) Composite Materials-Functional Materials for Modern Technology, DDL Chung, Springer- Verlag Publications London
4) The nature and Properties of Engg. Materials, Jastrzebaski, John Wiley & Sons, New York.

Reference Books:

1) Composite Materials Handbook, Mel M. Schwartz (R), 2nd Edition, 1992, McGraw-Hill, New York.
2) Fundamentals of Fiber Reinforced Composite Materials, A. R. Bunsell, J. Renard , 2005, IOP Publishing Ltd.
3) Composite Materials Science and Engg., Chawla K.K., Second Edition, 1998, Springer Verlag.

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ELECTIVE- I: 4. EXPERIMENTAL STRESS ANALYSIS

Teaching Scheme:
Lectures: 3 Hrs/Week
Practical: 2 Hr/Week/Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term Work: 25 Marks

Course Objective:

To familiarize the students with state of the art experimental techniques namely strain gauges, photo elasticity, interferometry, coating techniques, Moire fringes and holography employed in stress analysis.

Course Outcome:

The students shall demonstrate the knowledge of the state of the art experimental techniques namely strain gauges, photo elasticity, interferometry, coating techniques, Moire fringes and holography employed in stress analysis.

Unit-1
Introductory Principles
Basic concepts of experimental stress analysis (ESA), advantages, necessity of various ESA methods, methodology of problem solving by ESA. (4)

Unit-2
Strain Measurement Techniques
Introduction to strain measurement, Review of stress, strain and Hooke's law, Definition of stress and strain tensors, Strain gauges, Properties of strain gauge systems, Types of strain gauges, Mechanical and Optical strain gauges, Electrical strain gauges, LVDT, resistance strain gauges, Gauge factor, Materials for adhesion base etc, Recording instruments, static and dynamic recording. (8)
Strain Analysis Methods
Three element rectangular strain rosette, correction, stress gauges, over-deterministic methods for strain analysis, residual stress determination, Applications of strain gauges for measurement of load, temperature, pressure, vibration, stress and strain. (4)

Unit-3

Optical methods of Stress Analysis

Basics of optics, Optical instrumentation, Moire fringe technique – theory and experimental procedures, Fractional fringe measurement, Tardy's method, Babinet Soleil method. (5)

Unit-4

Theory of Photo elasticity – Two dimensional photo elasticity

Introduction, Temporary double refraction, Polariscope – Plane and Circular, Stress optic law, Different arrangements, photo elastic photography, properties of photo elastic materials, Selection, casting methods, calibration. Analysis techniques – determination of direction of principal stresses at a given point, determination of exact fringe order N and the principal stress separation methods, Method based on Hooke's law, Electrical analogy method, Shear difference method, Model to prototype scaling. (8)

Unit-5

Three dimensional photo elasticity

Stress freezing method, General slice, Effective stresses, stress separation, Shear difference method, Secondary principal stresses, Scattered light photo elasticity (5)

Unit-6

Coating Methods

Birefringent coating techniques, Stress-optic and strain-optic relation, Sensitivity and coating materials, Fringe order determination, Brittle coating technique, Moire technique. (4)

Holography

Introduction, Plane and spherical waves, coherence, holographic set-up, Interferometry – Displacement measurement, Isopachics. (2)

Term Work:

Minimum six assignments based on the above topics including two exercises involving analysis.

Text Books:

1) Dally and Riley, "**Experimental Stress Analysis**", McGraw Hill Book Company, 1991.
2) L. S. Srinath, "**Experimental Stress Analysis**", Tata McGraw Hill Book Company, New Delhi, 1984.
3) Sadhu Singh, "**Experimental Stress Analysis** ", Khanna Publishers, New Delhi, 1996.

Reference Books:

1) Holman, "**Experimental Methods for Engineers**", 7th Edition, Tata McGraw Hill Book Companies, Inc, New York, 2007

2) R.S Sirohi, H.C. Radhakrishna, " **Mechanical Measurements**", New Age International Pvt. Ltd, New Delhi, 2004.

3) Perry and Lissner, "**Strain Gauge Primer",** McGraw Hill, 1962.

4) Doeblin E. A.,"**Measurement Systems Application and Design**", McGraw Hill, New York, 1989

5) M.M. Frocht, "**Photoelasticity Vol I and Vol II**" John Wiley and Sons, 1969.

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ELECTIVE-I: 5. SAFETY ENGINEERING

Teaching Scheme:
Lecture 3 hrs/week
Practical 2 hrs/week

Examination Scheme:
Theory Paper (3 Hrs.): 100 marks
Term work 25 marks

Course Objectives:
To understand the fundamental concepts of safety engineering and learn the techniques for identification and control of industrial hazards

Course Outcome:
The student shall demonstrate the knowledge of fundamental concepts of safety engineering and the techniques for identification and control of industrial hazards

Unit-1
Industrial safety, Hazard identification and risk assessment, Preliminary hazard analysis (PHA), Failure mode effect analysis (FMEA), Job Safety Analysis, Accident causation, Accident investigation, Root cause analysis (6)

Unit-2
Safe design of plant layout and facilities, Emergency response preparedness, Designing safety features in machine and equipment, Poka-yoke for safe design and operation, Machine and equipment guarding, Personal protective equipment (6)

Unit-3
Foundry processes: Effects of heat, dust, and noise on worker fatigue and productivity, Working in hot environment, Hazards and safety precautions in melting, moulding, core making, fettling, and foundry material handling (6)

Unit-4
Metalworking processes: Hazards in hot forging and rolling operations, Safety in handling, storage and changeover of dies and rolls, Safe use of power presses, Safety precautions in shearing bending, rolling, drawing and other metalworking processes (6)

Unit-5
Machining processes: Designing safety features in machine tools, Common hazards in machining processes and their control. Safety in design and operations of material handling equipment. Industrial robots and robot system safety, Work envelope of robots, Sources of hazards in robot operations, Safeguarding personnel. (6)

Unit-6
Safety in maintenance operations, Work Permit Systems, Work in confined spaces, Working at height, Fabrication processes: Hazards in welding operations and their control. (6)

Term Work:
Any six of the following assignments, with an emphasis on obtaining and using field data.
1) Preliminary hazard analysis of a workplace
2) Failure mode effect analysis of a workplace and calculation of risk priority number

3) Improving design of a machine/ equipment using poka-yoke principles
4) Visit to a foundry and identification and classification of hazards
5) Visit to a forging/ rolling industry and identification and classification of hazards
6) Study of safety features of a robotic system
7) Study of safety features of material handling systems

Reference Books:

1) Industrial Accident Prevention, H W Heinrich, McGraw Hill, 1980
2) Occupational Safety Management and Engineering, W Hammer and D Price, Prentice Hall, 2000
3) Occupational Safety and Health: For Technologists, Engineers, and Managers. D Goetsch, Prentice Hall, 1999
4) Probabilistic Risk Assessment and Management for Engineers and Scientists, H Kumamoto and E Henley, IEEE Press, 1996

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ELECTIVE- I : 6. RAPID PROTOTYPING

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week Theory	Paper (3 Hrs): 100 Marks
Practicals: 2 Hrs. / Week/ Batch	Term work: 25 Marks

Course Objective:

To study the concepts and applications of rapid prototyping and rapid manufacturing

Corse Outcome:

The students shall have the knowledge of concepts and applications of rapid prototyping and rapid manufacturing.

Unit-1

Introduction to Rapid Prototyping:

Definition of rapid manufacturing (RM), rapid prototyping (RP) and rapid manufacturing, areas of application. Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification, RP Processes: Process overviews, STL file Generation, File Verification &Repair, Build File Creation, Part Construction, Part Cleaning and finishing, Process Strength & limitations. (6)

Unit- 2

Design Potential of Rapid Prototyping:

Conventional design for manufacturing and assembly (DFM, DFMA), impact of RM on DFA and DFMA, Geometrical freedom, design complexity/ optimization, parts consolidation, body fitting customization and multiple assemblies manufactured as one, Customer input and customization, CAD environment for RM. (6)

Unit- 3

Rapid Prototyping Processes-I:

a. Stereo lithography **(SLA):** Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages.
b. Laminated Object Manufacturing **(LOM):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.
c. Fused Deposition Modeling **(FDM)**: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. (6)

Unit- 4

Rapid Prototyping Processes-II:

a. Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.
b. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.
c. Laser powder forming: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. (6)

Unit- 5

Materials in RM:

Issues, viscous flow, photo-polymerization, sintering, infiltration, mechanical properties, Materials for RM processes, Prototype properties: Material properties, color, dimensional accuracy, stability, surface finish, machinability, Functionally graded materials (FGM composites), processing technologies for FGMs, thermal and mechanical properties of FGM, Deposition systems and applications. (6)

Unit- 6

Applications of RP:

Form and fit checking, Ergonomic Studies, Functional testing, Automotive applications- Parts ofracing cars, Applications in Aerospace industry, Construction industry, Applications in Medical field , Rapid Tooling: Mold making, Rapid tooling for die, permanent mold casting, Rapid manufacturing of sheet metal forming tools, casting pattern plates by rapid tooling, RP for series production investment casting. (6)

Term Work:

1) Three Assignments on 3D modeling & STL File generation of industrial components.
2) Assignment on introduction to Rapid manufacturing
3) Study of RP Processes along with working principles, set up, applications, advantages and limitations
4) Assignment on applications of rapid prototyping in various fields like automotive, aerospace, medical, construction etc.
5) Assignment on rapid tooling along with working principles, setup, applications, advantages and limitations

Reference Books:

1) Rapid Manufacturing: An Industrial Revolution for the Digital Age – Editors N.Hopkinson, R.J.M. Hague and P.M. Dickens, (2006) John Wiley & Sons, Ltd., ISBN-10 0-470-01613-2
2) T. A. Grimm & Associates, Users Guide to Rapid Prototyping, Society of Manufacturing Engineers (SME) ISBN 0872636976

3) Frank W. Liou, Rapid Prototyping & engineering applications, CRC Press, ISBN 978-0-8493-3409-2
4) Rapid Prototyping theory & practice, Manufacturing System Engineering Series, Ali K. Kamarani, Springer Verlag
5) Rapid Prototyping- case book, J. A. McDonalds, C. J. Ryall, Wiley Eastern
6) Rapid & Virtual Prototyping & applications, C. E. Bocking, AEW Rennie, Wiley Eastern
7) Carmen Gabriela BĂCILĂ, Zoltan-Gabor BAKI-HARI , " The Main Applications of Rapid Tooling," RECENT, Vol. 8, nr. 3a(21a), November, 2007
8) ANNALS of the ORADEA UNIVERSITY. Fascicle of Management and Technological Engineering, Volume VI (XVI), 2007
9) John F. Wallace, David Schwam," Rapid manufacturing of sheet metal formingtools," Case Western Reserve University
10) A. Pereira, J.A. Pérez, J.L. Diéguez, G. Peláez and J.E. Ares, "Design and manufactureof casting pattern plates", by rapid tooling, Archives of Materials Science, Vol. 29, No. 1-2, 2008 63
11) Using RP for Series Production Investment Castings, Tom Mueller, Express Pattern

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ELECTIVE-I : 7. RELIABILITY ENGINEERING

Teaching Scheme:	**Examination Scheme:**
Lecture 3 hrs/week	Theory Paper (3Hrs): 100 marks
Practical 2 hrs/week	Term work 25 marks

Course Objective:
To understand fundamental concepts of reliability and learn the models for component and system reliability.

Course Outcome:
The students shall have the knowledge of fundamental concepts of reliability and the models for component and system reliability.

Unit-1
Introduction to reliability, Definitions, Reliability in product life-cycle, Quality, Failures, Failure data, Failure models, Causes of failures, Maintainability and availability, System effectiveness, Redundancy techniques (4)

Unit-2
Probability, Axiomatic probability, Statistical probability, Rules of probability, Random variables, Discrete distributions: Binomial and Poisson distribution, Continuous distributions: Uniform, Exponential, Weibull, Normal, Rayleigh, Gamma distribution (6)

Unit-3
Component reliability, Mean time to failure (MTTF), Time-dependent hazard models: Field-data, Constant hazard, Linear hazard, Nonlinear hazard, Gamma model, Stress-dependent hazard models, Markov model (8)

Unit-4
System reliability, Components in series, Components in parallel, k-out-of-m systems, Mixed-mode failures, Fault-tree technique, Failure mode effect analysis (FMEA), Risk priority number (RPN) (8)

Unit-5
Maintainability function, Mean time to repair (MTTR), Availability function, Preventive maintenance, Redundancy techniques, Unit redundancy, Component redundancy, Weakest-link technique, Mixed redundancy, Standby redundancy (6)

Unit-6
Economics of reliability, Manufacturer's cost, Customer's cost, Reliability achievement cost, Reliability utility cost, Depreciation cost, Availability cost for parallel systems (4)

Term work:
Any six of the following assignments, with an emphasis on obtaining and using field data.

1) Plotting bath-tub curve using failure data of a machine/equipment/system
2) Estimation of parameters of statistical distribution from failure data of a machine
3) Calculation of hazard rate of a system using appropriate hazard model
4) Estimation of failure rate and system reliability using fault-tree diagram
5) Comparison of system reliability applying different redundancy techniques
6) Estimation of MTTF, MTTR, and availability of a machine from failure data
7) Failure mode effect analysis for an equipment/system and estimation of risk priority number

Text Books:
1) Reliability Engineering and Life Testing, V N A Naikan, Prentice Hall, 2008
2) Reliability Engineering, E Balagurusamy, Tata McGraw Hill, 2008

Reference Books:
1) Principles of Reliability Engineering, K B Misra, Reliability Engineering Centre, IIT Kharagpur, 2004.
2) Maintenance Engineering and Management, S K Srivastava, S Chand, 2008
Terotechnology: Reliability Engineering and Maintenance Management, B Bhadury and S K Basu, Asian Books, 2003.

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6. INDUSTRIAL TRAINING

Teaching Scheme:
Not Applicable.

Examination Scheme:
Term work: 25 Marks
External Oral Examination: 25 Marks

Course Objective:
To expose the students to industrial work systems and working environment.

Course Outcome:
The students shall have the knowledge of industrial work systems and working environment.

Term Work:
Every student shall prepare a report of the industrial training and the case studies carried out during at least a 15 days vacational in-plant training in a prescribed format under the guidance of the Project Guide, before end of Part I, semester VII. The report shall be comprehensive and presented in duplicate, typed on standard A4 size sheet and bound. This will form the term work.

The Training Contents:
The student shall undergo training program prepared by the industry in following manufacturing and functional area.

1) Plant Engineering: Plant Layout, Plant Maintenance, Housekeeping, Material Handling & safety.
2) Production Planning And Control, Quality Assurance.
3) Material Management: Inventory Control, Vendor Development, Vendor Rating, Raw
4) Material and Finished Goods stores.
5) Manufacturing Processes: Machines & Equipments, Its working, Machine / Process Diagnosis.
6) Industrial Engineering: Method Study, Work Measurement, Ergonomics and Productivity
7) Improvement Technique.
8) Costing and Cost Control.
9) Management Information System (M.I.S.). /Enterprise Resource Planning (ERP) System.
10) Incentive Schemes, Labor Laws. Factory Acts.
11) Quality Assurance, Quality Improvement.
12) Improvement in tool layout, tool selection machine selection.
13) Maintenance of machines, housekeeping, safety precautions.
14) Computer based information study for stores, purchase wastage of material, In process
15) Material planning and scheduling, assembly of storage of finish product dispatch.

The students shall submit a detailed report on his/her in-plant training including case studies.

Notes: The Reports of students undergoing training in the same organization must include different case studies. The project guide shall assess the term work.

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7. PROJECT WORK- Phase-I

Teaching Scheme: **Examination Scheme:**
Practical: 4 Hrs./Week/Batch Term work: 75 Marks

Course Objective:
To prepare the students to carry out a comprehensive study of any design or process or phenomenon, to encourage the process of independent creative thinking and working in groups and to expose them to industrial atmosphere of accountability.

Course Outcomes:
The students shall have the ability to carry out a comprehensive study of any design or process or phenomenon as well as independent creative thinking and working in groups with exposure to industrial atmosphere of accountability.

Term Work:
The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The work started in Semester VII will be continued in the Semester VIII and the final submission of the report will be at the end of the Semester VIII.

The project work may consist of-
1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing it.
4. Experimental verification of principles used in applications related to Production or Mechanical Engineering.
5. A combination of the above.

A synopsis of the selected project work (two to three pages typed on A4 size sheets) will be submitted and assessed by the Project Guide and one more faculty member appointed by the Department / concerned responsible official of the sponsoring industry/Co-guide.
The work to be completed in Semester VII shall include-
a) Problem Identification
b) Methodology / Design Documents
c) Activity planning for the time frame and **division of responsibility to each student**. An interim report of the work completed in Semester VII in the form of workbook /project diary and other relevant documents shall be submitted for the term work. The term work shall be assessed by the Guide and one more faculty member appointed by the Head of the Department. The assessment shall be based on a presentation of the work completed and submission of interim report.
The oral examination shall be based on the work planned and actually completed in Semester-VII.

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1. COSTING AND COST CONTROL

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objectives
1) To gain the fundamental knowledge about the costing system.
2) To understand the process of costing for different industries.
3) To learn the cost accounting methods.
4) To learn the techniques of costing in cost control and cost reduction areas.

Course Outcomes
1) The student shall demonstrate the fundamentals of Costing System.
2) The student shall apply the costing methods based on type of industry.
3) The student shall be able to apply the different Cost accounting methods as per requirement.
4) The student shall demonstrate his acquired skills in Cost control and Cost Reduction.

Unit-1

Cost and Cost Estimation: Concept of cost, cost unit, cost center, classification of cost, elements of cost, Definition of costing, desirable conditions for a costing system. Cost sheet. Cost Estimating**:** Definition, purpose and functions of estimation, role of estimator, constituents of estimates, estimating procedures.(5)

Unit-2

Estimation of Weight and Material Cost: Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost. Purchasing procedure, Inventory Valuation by LIFO, FIFO, Weighted average method. (8)

Unit-3

Estimation of fabrication, foundry, forging and machining cost

Constitutes, direct cost, indirect cost, Procedure of estimation of cost for each type. Machine hour rate: definition, constituents, direct cost, indirect cost, steps for estimation of machine hour rate for conventional machines, CNC lathe and machining center. (6)

Unit-4

Overheads: Elements of overheads, classification, general considerations for collection, analysis of overheads, different methods for allocation, apportionment, absorption of overheads. (6)

Unit-5

Cost Accounting Methods: Job costing, Batch costing, Unit costing, Process costing, Contract costing, Activity based costing. (5)

Unit-6

Cost Control: Budget and budgetary control, standard cost, variance analysis, Cost Reduction Areas: Value analysis and Value engineering, Zero Base Budgeting, Cost Volume profit Analysis, Profit volume ratio (5)

Note: Numerical treatment on units1, 2, 3, 4 and 5 is essential.

Term Work:

Note: Use of computers is essential for at least one exercise.

1. Estimation of weight and material cost for an assembly of three to five components.
2. Valuation of inventory by LIFO, FIFO, Weighted average method
3. Estimation for machine hour rate for representative machines – one conventional machine and one CNC lathe or machining center.
4. Case study on estimation of overheads for a manufacturing unit
5. Study of different methods for allocation, apportionment, absorption of overheads
6. Case study in any one industry using any of the method of costing.
7. Different examples illustrating cost control
8. Case studies of cost reduction

Reference Books:

1. Principles & Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.)
2. Costing Simplified: Wheldom Series – Brown &Owier (ELBS)
3. Cost Accounting: B. Jawaharlal (TMH)
4. Cost Accounting: R.R. Gupta.
5. Cost Accounting, 13/e - B. K. Bhar, (Academic Publishers, Kolkata)
6. Cost Accounting: Jain, Narang (Kalyani Publishers)
7. A Text Book of Estimating and Costing Mechanical – J.S. Charaya & G. S. Narang (Satya Prakashan)

8. Mechanical Estimation and Costing – TTTI, Chennai (TMH)
9. Theory & Problems of Management & Cost Accounting – M.Y. Khan, P. K. Jain (TMH)

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2. INDUSTRIAL ENGINEERING

Teaching Scheme
Lecture: 3hrs/week
Practical: 2hrs/Week/Batch

Examination Scheme:
Theory Paper (3 Hrs.): 100 marks
Term work: 25 marks
External Oral Examination: 25 Marks

Course Objective:
To acquire interdisciplinary knowledge of method study, work measurement techniques and ergonomics for the overall improvement of productivity and effectiveness.

Course Objective:
The student shall demonstrate an interdisciplinary knowledge of method study, work measurement techniques and ergonomics for the overall improvement of productivity and effectiveness.

Unit-1
Introduction to Productivity and Work Study: Definition and scope, Productivity and quality of life, Evolution of work study, contribution of Taylor and Gilbreth, Work study techniques and basic procedure, Human factor in application of work-study.
Method study:
a) Definition, objectives and basic procedure.
b) Record, Examine, Develop – Process chart symbols, Outline and flow process charts, Flow diagrams, Critically Examine Techniques
c) Movement of workers and material – string diagram, flow process charts worker Material and equipment type, multiple activity chart – Man – Machine, Machine- Machine chart, Travel charts for workplace
d) Methods and Movements at workplace- Principles of motion economy, Classification of movements, Two handed process chart, SIMO chart, Micro Motion study, Therbligs.
e) Evaluate, Define, Install and Maintain methods (12)

Unit-2
Working conditions and Environment: Occupational hazards, health and safety, housekeeping, lighting, noise and vibrations, climatic conditions, ILO norms
Ergonomics: Human factor engineering, man- machine interaction, **Design of controls, environment factors, Anthropometry, workplace design.** (5)

Unit-3
Value Engineering: Introduction, Concept, Difference between Value Engineering and Value Analysis, Case study. (2)

Unit-4
Work Measurement:
Definition, objectives, basic procedure, Techniques of work measurement, Time study – Equipment and forms, selection of a job, steps in time study, breaking the job into elements, timing the elements; Rating

in time study – standard rating and standard performance, factors affecting rate of working, standard time determination, use of time standards, allowances;
Work sampling – Need, procedure for work sampling, determining time standard by work sampling.
Predetermined time standards (PTS) – definition, methods time measurement (MTM) standard data from PTS, applications of PTS
MOST (Maynard Operation Sequence Technique) – Introduction, Methodology (9)

Unit-5
Location Layout:
Factors affecting site selection, factors affecting layout design, types of layout, systematic layout planning procedure, travel chart, information gathering, flow analysis and activity analysis relationship diagram, space requirement and availability, designing of layout – use of CAD; Material Handling Systems– Principles, functions and equipments, **selection of MH systems, unit load concept in MH, Economics of material handling.** (5)

Unit-6
Job Evaluations and Merit Rating: Job analysis, Ranking system, Grade description system, Point system, Factor comparison system; Method of merit rating systems,
Incentives: Types of Incentives, Relationship of motion and time study with the incentives. (5)

Term Work:
1. At least one industrial visit to study applications related to the subject and submission of the relevant report.
2. Method study with present and proposed methods for a manufacturing related task
3. Design and drawing of work place layout in a manufacturing environment considering Ergonomics factors
4. Industrial case study on Plant layout design.
5. Time study for a processing operation on a job and calculation of standard time
6. One experiment on micro motion study with the help of video camera./ Case study on Job & merit rating/ Case study on relationship of motion & time study with incentives.
7. A case study on Value Engineering.

Reference Books:
1. Work Study: - I L O
2. Work Study: - Curie and Faraday (ELBS)
3. Industrial Engineering Handbook, Maynard (Mc Graw Hill)
5. Time and Motion Study Design, Barnes, R.M. (John Wiley)
4. Work Study & Ergonomics, L.C. Jhamb (Everest)
5. Facility Layout and Location – An Analytical Approach, Francis et. al.(PHI)
6. Facilities Planning – 3/e, Tompkins, White, Bozer, Tanchoco (John Wiley & Sons)
7. Job Evaluation - ILO
8. Payment by Results, - ILO
9. Work Study by O.P. Khanna (Dhanapat Rai and Sons)

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3. FINITE ELEMENT ANALYSIS

Teaching Scheme:
Lectures: 4 Hrs. / Week
Practical: 2 Hr. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks
External Practical Examination: 25 Marks

Course Objectives:

1) To understand Finite Element Methods
2) To develop an ability to-
   a) Analyze 1D, 2D structural analysis problems
   b) Analyze thermal analysis problems
   c) Use of translators for import export of CAD models.

Course Outcomes:

At the end of this course, Students are able to-

1. To calculate deflection, stress and strain in structural analysis
2. To calculate temperature at various nodes
3. To select and use appropriate translator for CAD data.

Unit-1: Introduction to Finite Element Method: Basic Concept, Historical Background, Engineering applications, general Description, comparison with other methods. **Integral Formulation and Variation Methods:** Need for weighted-integral forms, relevant mathematical concepts and formulate, weak formulation of boundary value problems, variational methods, Rayleigh-Ritz method and weighted residual approach. (8)

Unit-2: Finite Element Techniques: Module boundary value problem, finite element decartelization, element shapes, sizes and node locations, interpolation functions, derivation of element equations, connectivity, boundary conditions, FEM solutions, post processing, Compatibility and completeness requirements, convergence criteria, higher order and isoparametric elements, natural coordinates, Lagrange and Hermit Polynomials. (10)

Unit-3: Fundamental of Solid Mechanics : concepts of Stress Strain Curve, true stress, true strain, stress tensor, strain tensor, Plane stress and strain, Principal stress and strain, yield criteria- Tresca and Von Mises
Analysis of 1D element: Analysis of Spring Element: stiffness matrix, displacement, stress
Analysis of Link element: 1d link, Matrix formation, Calculations of displacement, stress and strain. (12)

Unit-4: Analysis of 2D truss element: Calculations of displacement stress and strain. Analysis of 2D plane element, Calculation of stress, strain (10)

Unit-5: Applications to Heat Transfer Problems: Variational approach, Galerikn approach, one dimensional and two dimensional steady state problems for conduction, convection and radiation, transient problems. (5)

Unit-6: Standards for CAD: Need, Graphics and Computing standards, Data Exchange standards, Communications Standards (3)

Term Work:
1. Analysis of spring element using any suitable software
2. Analysis of bar element using any suitable software package
3. Analysis of 2D spar truss any suitable software package
4. Area meshing exercise
5. Study of translators
6. At least two meshing exercises based on free and mapped meshing
7. Mini-project based on CAD and CAE software#.

Any type of case study using CAD, CAE software can be considered for Mini-project.
External oral should be based on term-work only.

Reference Books:

1. "Introduction to Finite Elements in Engineering"; Chandrapatala, Belgundu, PHI.
2. "Finite Element Methods for Engineers"; U.S. Dixit, Cengage Learning.
3. "An Introduction to Finite Element Method"; J. N. Reddy; 2/e, McGraw Hill International Editions, ISBN 0-07-112799-2
4. "Finite Element Analysis – Theory and Practice"; M.J. Fagan, Longman Scientific & Technical.
5. "The Finite Element Method – Basic Concepts and Linear Applications"; O. C, Zienkiewicz; McGraw Hill International Editions; ISBN 0-07-084175-6
6. "Practical Finite Element Analysis", N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N. Thite, Finite to Infinite Publication.
7. The Finite Element Method For Engineers – Huebner Willy India
8. Concepts of Finite Element Methods by Manicka Selvam SCITECH publication
9. A First Course in the Finite Element Analysis By D.L.Logan CENGAGE Learning
10. User manual of concerned analysis software package.

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ELECTIVE- II : 1. PRODUCT DESIGN AND DEVELOPMENT

Teaching Scheme:
Lectures: 3 hrs/week
Practicals:2 Hrs./Batch/Week

Examination Scheme:
Theory Paper (3 Hrs.): 100 Marks
Term Work: 25 Marks

Course Objectives:
To understand the basic as well as the advanced knowledge of product design and development process and its application.

Course Outcomes:
The students shall demonstrate the knowledge of basic as well as the advanced product design and development process and its application.

Unit-1
Introduction to Product Design & Development:
Definition Of Product Design, Design By Evolution And Innovation, Factors In Product Design, Morphology Of Product Design (Seven Phases), Standardization, Simplification and Specialization In

Product Design, Modern Approaches- Concurrent Design and Quality Function Deployment (QFD), Product Development, Product Development versus Product Design, Types Of Design And Redesign, Modern Product Development Process, Product Development Team And Product Development Planning With Reference To ISO Standard, Difference Between Product Verification And Production Validation, Introduction To Prototyping, Rapid Prototyping Methods. (6)

Unit- 2

Product Development - Technical and Business Concerns:

Technology Forecasting and Technology S-Curve (Technology Stage), Mission Statement and Technical Questioning, Economic Analysis of Product, Customer Needs and Satisfaction, Customer Population and Market Segmentation, Customer Needs-Types and Models, Gathering Customer Needs Information, Analysis *of* Gathered Information. (6)

Unit- 3

Product Development from Concept to Product Function:

Generating concepts, information gathering, and brainstorming, morphological analysis, concept selection-design evaluation, estimation *of* technical feasibility, concept selection process, Pugh's concept, selection charts, numerical concept scoring, process of concept embodiment, system modeling, FMEA, functional modeling and decomposition, fast method, subtract and operate procedure, establishing system functionality, augmentation and aggregation. (7)

Unit-4

Product Development in the Context of Reverse Engineering:

Product Teardown Process, Tear Down Methods - Force Flow Diagrams, Measurement and Experimentation, Applications of Product Teardown, Benchmarking Approach and Detailed Procedure, Tools Used In Benchmarking - Indented Assembly Cost Analysis, Function -Form Diagrams, Trend Analysis, Setting Product Specifications, Introduction to Product Portfolio and Architecture. (7)

Unit-5

Design for Manufacture, Assembly and Environment:

Design guidelines, design for manufacture, design for assembly, design for piece part production, manufacturing cost analysis, need and importance of design fo*r* environment, global, local and regional issues, basic DFE methods-guidelines and applications, life cycle assessment - basic method, weighed sum assessment method, life cycle assessment method, DFX, product testing, product validation, field trials, virtual trials, iterations. (7)

Unit-6

Introduction to Product Life Cycle and Product Data Management:

Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components/Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement, Product Data and Product Workflow, The Link Between Product Data and Product Workflow, Different Phases of Product Life Cycle and corresponding technologies. Reliability concepts in product development. (7)

Term Work:

The term work shall consist of total Six assignments based on each of the above mentioned units.

Text Books & Reference Books:

1) Kevin Otto and Kristin Wood" Product Design: Techniques in Reverse Engineering and New Product Development," Pearson Education Inc.
2) A.K. Chitale; R.C. Gupta, "Product Design and Manufacturing" Prentice Hall India

3) Dieter George E., "Engineering Design" McGraw Hill Pub. Company, 2000.
4) Grieves, Michael" Product Lifecycle Management", McGraw-Hill, 2006. ISBN0071452303
5) Bralla, James G Handbook of Product Design for Manufacturing, McGraw Hill Pub.1986
6) ISO Standard: 9001:2008: Clauses 7.1, 7.2, 7.3
7) Kevin Otto and Kristin Wood, ―Product Design – Techniques in Reverse Engineering and New Product Development‖, Pearson Education, 2004.
8) Karl T Ulrich and Stephen D Eppinger, ―Product Design and Development‖, McGraw Hill, 1994.
9) Grieves, Michael. Product Lifecycle Management, McGraw-Hill, 2006. ISBN0071452303
10) Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management, Springer, 1st Edition (Nov.5, 2003)
11) Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer-Verlag, 2004. ISBN 1852338105

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ELECTIVE -II: 2. ADVANCED MACHINE DESIGN

Teaching Scheme:
Lectures: 3 Hrs/Week
Practical: 2 Hr/Week/Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term Work: 25 Marks

Course Objectives:

1) To understand the fundamentals of elasticity in comparison with the mechanics of deformable bodies.
2) To develop systematic knowledge of basic concepts like stress, strain, equilibrium, compatibility and failure theories.
3) To relate the stresses and strains in terms of elastic constants and understand the importance of these constants.
4) To become acquainted with the fundamental concepts of stress analysis in two dimensions using stress functions.
5) To understand the behaviour of prismatic bars subjected to torsion.
6) To understand the concept of strain energy and the relevant energy methods for the solution of engineering problems.

Course Outcomes:

At the end of this course the students will be able to -

1) Be proficient with the basic concepts of elasticity and understand the limitations of the 'Strength of Materials'.
2) Apply the analytical techniques to :(i) determine internal forces, stresses and strains (ii) predict failure of simple components.
3) Characterize materials with elastic constitutive relations.
4) Obtain solutions to simple beam problems (cantilever, simply supported) using stress functions.
5) Seek stresses in prismatic bars subjected to torsion (using membrane, soap-film analogy).
6) Utilize the energy methods and obtain solutions to elastic bodies subjected to various loads.

Unit- 1

Analysis of Stress:

Basic concepts: Body force, Surface Force, Stresses, Components of Stresses, State of stress at a point, Stress components on an arbitrary plane, Principal stresses, Shear stresses, Stress transformation, Introduction to Mohr's circle, Plane stress, Differential equations of equilibrium, Boundary conditions, Stress invariants, Octahedral stresses, Decomposition of a state of stress. (9)

Unit- 2

Analysis of Strain:

Deformation, Strain displacement relations, Strain components, State of strain at a point, Dilatation, Compatibility conditions, Plane strain (5)

Unit- 3

Stress- Strain relations:

Generalized Hooke's Law in terms of elastic constants, Relations between elastic constants, Displacement equations of equilibrium, Saint Venant's principle. (4)

Unit- 4

Two dimensional problems in Cartesian co-ordinates:

Airy's stress function, Biharmonic equilibrium equations, Study of simple beam problems: (a) Bending of a cantilever beam with end load, (b) Simply supported beam with uniform load. (4)

Unit- 5

Analysis of axi-symmetric problems and Torsion:

Axi-symmetric problems: General equations in polar co-ordinates, Thick-walled cylinder subjected to external and internal pressure

Torsion: Torsion of prismatic (circular and elliptical cross-section) bars, Soap film logy. (6)

Unit- 6

Energy Methods:

Concept of elastic strain energy, Strain energy due to axial force, shear force, torsion, bending moment, Principle of superposition, Maxwell-Betti-Rayleigh reciprocal theorem, Castigliano's theorems, Principle of virtual work. (8)

Term Work:

Minimum six assignments based on the above topics including two exercises involving analysis (Analytical or FEA) and design modification for a component.

Text Books:

1) S. P. Timoshenko and J N Goodier, "**Theory of Elasticity**", McGraw Hill Book Company.
2) L. S. Srinath, "**Advanced Mechanics of Solids**", Tata McGraw Hill Book Company.
3) Richard G Budynas, "**Advanced Strength and Applied Stress Analysis",** McGraw Hill , New Delhi, Second Edition, 2011.

Reference Books:

1) Sadhusingh, "Theory of Elasticity", Khanna Publishers, New Delhi, Fourth Edition, 2012.
2) Wang C. T. , "Applied Elasticity", McGraw Hill, New Delhi, 1990.
3) L. D. Landau and E. M. Lifshitz, "Theory of Elasticity", Vikas Publishing House Pvt. Ltd, New Delhi.
4) T. G. Sitharam, "Applied Elasticity", Interline Publishing.
5) Phillips, Durelli and Tsao, "Analysis of Stress and Strain" McGraw Hill Book Company.

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Elective- II: 3. ADVANCED TOOL & DIE DESIGN

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objective:
To study principles of designing fixtures and dies for industrial applications.

Corse Outcome:
The students shall have the knowledge of the principles of designing fixtures and dies for industrial applications.

Unit-1
Introduction: Jigs and Fixtures, Flexible Fixture, Materials for Tools, Fixture and Dies.**. Modular Fixture Systems**: Development of modular fixtures, T- slot based and Dowel pin based Modular Fixture systems, Interactive Computer Aided Fixture Design (I-CAFD) Structure, Locating / clamping Model Analysis and classification, Fixture Component Selection, Fixture component Assembly Manipulation.(9)

Unit-2
Group Technology based Computer Aided Fixture Design: Fixture Design process analysis, Fixture Structure Analysis, Fixture Feature Analysis, Fixture Design Similarity Analysis, Representation of Fixture, Feature information, Automated Fixture configuration Design. (6)

Unit-3
Geometric and Accuracy Analysis: Geometric constraint conditions, Assembly Analysis, 3-D Fixture configurations, Locating Accuracy and Error analysis, clamp planning, Machining accuracy analysis.(5)

Unit-4
Basic Principles of Metal Forming: Flow conditions and flow curve, Deformation and material flow, force and work, Formability.**Die Design for Hydro Forming:** Process Technology, Die design considerations, die layout, die clamping, lubricants. (8)

Unit-5
Die Design for Deep Drawing and Stretch Drawing: design considerations, die materials, efforts of friction, wear and lubrication, Die handling, Die clamping, dies for hydro mechanical deep drawing. (5)

Unit-6
Extrusion Dies: Die Design for metal and plastic extrusion, die materials, die clamping, die handling, Dies for Solid Sections, Dies for hollow section. (7)

Term Work:
The term work shall consist of all of the following assignments.

1) Case Study of T- Slot based Modular Fixture system.
2) Case Study of Dowel pin based Modular Fixture system.
3) Computer Aided Fixture Design for Simple Component.

4) Die Design for stretch drawing operation for a component.
5) Extrusion die design for solid section in plastic.
6) Study of die clamping systems for various processes.

Reference Books:

1) Rong, Yeming; "Computer Aided Fixture Design", Marcel Dekker, ISBN 0-8247-9961-5
2) Metal Forming Handbook – Schuler, Springer- Verlag Berlin.
3) Dies for Plastic Extrusion – M.V. Joshi – Mc Millan.
4) Tool Design – C. Donaldson, LeCain & Goold (TMH)
5) Tool Design – H.W. Pollack (Taraporwalla)
6) ASM Handbook – Forming – ASME
7) Handbook of Die Design, 2/e – Suchy, I (McGraw Hill), 2006.
8) Design of Jigs and Fixtures – Hoffman (Pearson)
9) An Introduction to Jig & Tool Design, M.H.A. Kempster, (ELBS)
10) Jigs and Fixture Design Manual, Henrikson (Industrial Press, NY)
11) Die Design Fundamentals, J. R. Paquin, R. E. Crowley, Industrial Press Inc.
12) Jigs & Fixtures; Design Manual – (2/e), P.H. Joshi, (TMH) (2003)

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Elective-II: 4. MATERIAL HANDLING SYSTEMS

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objective
To study material handling equipments their selection, design concepts and applications.

Course Outcome:
The students shall have the knowledge of material handling equipments their selection, design concepts and applications.

Unit-1
Introduction: Definition, scope, basic concepts, principles of material handling, economics of handling, Concepts of unit load, containerization and palletization. **Facilities Design Function:** Scope, objectives and types; relationship of plant layouts with material handling, factors to be considered for plant layout design; Space planning for various activities like office, storage, and production etc., factors - area allocation, location, relative positions, future expansion. (10)

Unit-2
Material Flow: Operation sequence, material flow pattern, Part flow analysis in group technology, stages of material flow - at receiving, in process and at shipping, flow planning criteria and design of flow pattern. (5)

Unit-3
Warehousing: Concept, Types, Storage and design considerations for in-house warehouses. (2)

Unit-4

Equipment for Material Handling Systems for Various Materials:

a) Storing equipments like pallets, bins, racks, decking, order picking, positioning equipments. (4)

b) Hoisting equipment like jacks, pulleys, hand trolleys, hoists, power hoist, various types of cranes and elevators. (3)

c) Equipment for Material Movement: i) Conveying equipments like belt, chain, roller, wheel, trolley, tray conveyors, gravity and vibratory type conveyors, screw conveyors. (3)

ii) Mobile equipment like hand trucks, fork lift trucks, powered industrial trucks and tractors, powered stackers, reach trucks, order pickers. (3)

Unit-5

Design and Selection of M. H. Equipment: Factors affecting, procedure for selection, design of conveyor, electric hoist, case studies (4)

Unit-6

Automated Material Handling: Need, Comparison with conventional systems, equipments like industrial robots and automatically guided vehicles, ASRS, use of simulation software for design of m. h. system. **Safety and Training:** Need, environmental and human factors in material handling. (5)

Term Work:

Assignments Sr. no. 1 to 4 shall consist of the industrial case studies.

1. Study of Facility design
2. Study of Material flow analysis
3. Study of Storing and hoisting equipments
4. Study of Conveying and mobile equipments
5. Selection of M.H. equipments and design of conveyor/electric hoist.
6. Exercise on design / simulation of M.H.S. using simulation software like FLEXSIM or similar
7. Industrial visit to study material handling practices and its report

Reference Books:

1. Material Handling - Immer J. R. (McGraw Hill)
2. Plant Layout & Material Handling - James Apple (John Wiley)
3. Material Handling System Design - James Apple ((John Wiley)
4. Material Handling Principles & Practice - Theodore H. Allegre Sr. (CBS Publishers & Distributors)
5. Facilities Planning – 3/e, Tompkins, White, Bozer, Tanchoco (John Wiley & Sons)
6. Material Handling Handbooks
7. Work Study - O. P. Khanna (Dhanpatrai & Sons)

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Elective-II: 5. ARTIFICIAL INTELLIGENECE

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Corse Objective:

To understand the fundamental concepts of Artificial Intelligence and its applications.

Course Outcome:
The students shall demonstrate the knowledge of the fundamental concepts of Artificial Intelligence and its applications.

Unit-1
Introduction: Concept of AI, approaches – acting and thinking like humans and rationally, brief history of A.I, foundations of A.I, underlying assumptions, application areas. (3)
Problem formulation: Problem solving agents, components of problem definition, defining the problem as state space approach, Problem characteristics, Production system, searching for solutions ,Forward & Backward reasoning, means end analysis, Graphs and Trees, measuring problem solving performance. (4)

Unit - 2
Search Strategies: a) Uninformed (blind) search – breadth first, depth first and their variations, avoiding repeated states b) Informed (Heuristic) Search – evaluation /heuristic function, generate and Test, Best first search, A* search, Local search algorithms – Hill climbing, simulated annealing, local beam search, Branch & Bound search, Genetic Algorithms, terminology. (5)

Unit - 3
Knowledge Representation: Simple relational knowledge, Inheritable knowledge, Inferential knowledge, Procedural knowledge, the frame problem, Propositional Logic–Syntax and semantics, properties of statements, Inference rules, First Order Predicate Logic: syntax and semantics, well formed formulas (WFF), Properties of WFFs, conversion to clausal form, using FOPL, inference rules, unification, non-deductive inference methods, resolution, forward and backward chaining, the knowledge engineering process. Handling uncertain knowledge, probability propositions, atomic events, unconditional (prior) and conditional (posterior) priority, Bayes' rules and its use, Bayesian network and its semantics, inference in Bayesian networks. (7)

Unit - 4
Learning: Forms of learning, inductive learning, decision trees learning, ensemble learning, pattern recognition: introduction, recognition and classification process, learning classification patterns. (4)
Knowledge Based Systems: Expert systems, components, characteristic features of expert systems, applications, rule based system architecture, representing and using domain knowledge, expert system shell, explaining the reasoning and knowledge acquisition, applications. (6)

Unit - 5
A.I. in Robotics: State space search, Block word and robot example, path selection, Monkey and Banana problem, AND – OR graph, means end analysis in a robotic problem, robot problem solving as a production system, triangle table, robot learning, robot task planning, phases in task planning, symbolic spatial relationships, obstacle avoidance, graph planning. (6)

Unit - 6
Machine Vision: Introduction, functions in a vision system, imaging devices, lighting, A-D conversion, quantization, encoding image storage, image data reduction, segmentation techniques, feature extraction, object recognition, training the vision system, robotic applications of machine vision. (5)

Term Work:
The term work shall consist of the following.
1. Minimum Six programming exercises using a suitable language (e.g. PROLOG, LISP, C++ etc.) preferably in manufacturing related area.
2. One case study on application of A.I. & E.S. in Manufacturing Engineering /Management.

Reference Books:

1. Artificial Intelligence: A Modern Approach- 2 /e (2003) Stuart Russel, Peter Norvig (Pearson Education).
2. Artificial Intelligence: 2/e (1991)- Elaine Rich, Kevin Knight (TMH).
3. Introduction to Artificial Intelligence & Expert Systems – Dan W. Patterson. (Seventh Indian Reprint 1999) (EEE) (PHI).
4. Handbook of Expert Systems in Manufacturing – Rex Mauss, Jessica Keyes (Mc Graw Hill).
5. Industrial Robotics – Technology, Programming and Applications - Groover, Weiss, Nagel, Odrey, (Mc Graw Hill).
6. Robotics: Control, Sensing, Vision and Intelligence – Fu, Gonzalez and Lee. (McGraw Hill).
7. Conference Proceedings & Current Journals for case studies and applications.

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Elective-II: 6. INDUSTRIAL ROBOTICS

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objective:
To study fundamentals, analysis, applications and programming for industrial robots.

Course Outcome:
The students shall have the knowledge of fundamentals, analysis, applications and programming of industrial robots.

Unit-1
Introduction: Automation and Robotic System, Anatomy and work volumes, Classification. **Drives & Control System:** Hydraulics and pneumatic actuators, electrical drives for robotics, control loops, basic control system concepts and models, control system analysis, robot activation & feedback components, position and velocity sensors, power transmission system. (6)

Unit-2
a) Robot & Peripherals: End effecters – types, mechanical electromagnetic, pneumatic grippers, tool as end effecter, robot end effecter interface. Sensors – sensors in robotics, tactile sensors, proximity and range sensors, sensor based systems and uses.
b) Machine Vision- Introduction, low level and high level vision, sensing and digitizing, image processing and analysis, segmentation, edge detection, object description and recognition, interpretation, applications. (8)

Unit-3
Programming for Robots: Methods, robot program as a path in space, motion interpolation, characteristics of robot level and task level languages, robot languages, programming in suitable languages, Simulation of robot programs. (6)

Unit-4
Robot Kinematics: Introduction, forward, reverse & homogeneous transformations, manipulator path control, introduction to robot dynamics configuration of a robot controller. (6)

Unit-5

Robot Intelligence and Task Planning: Introduction, state space search, problem reduction, use of predictive logic, means – ends analysis, problem solving, robot learning, robot task planning. (6)

Unit-6

Robotic Applications: Applications in manufacturing -material transfer, machine loading and unloading, processing operations, assembly and inspections, robotic cell design and control, applications in other areas: toxic, hazardous and inaccessible, service industry. **Social Issues-** safety and economics in robotics. (8)

Term Work:

Minimum Six exercises from following.

1) Two Programming exercises for robots.
2) Three case studies of applications in industry involving working out the scheme with type of
3) robots, other accessories with sequence and logic.
4) Three exercises using a suitable robotic simulation software for handling applications.

Reference Books:

1) Industrial Robotics: Technology, Programming & Applications- Groover, Weiss, Nagel, Ordey McGraw Hill
2) Robotics: Control, Sensing, Vision & Intelligence. - Fu, Gonzalez, Lee (McGraw Hill)
3) Robotics Technology & Flexible Automation – S.R. Deb (TMH)
4) Handbook of Industrial Robotics – Ed. Shimon Y. Nof (John Wiley.)
5) Fundamental of Robotics, Analysis & Control – Robert J. Schilling (PHI)
6) Robotics for Engineers – Yoram Koren (McGraw Hill)
7) Introduction to Robotics: Analysis, Systems & Applications – Saeed B. Niku (Pearson Education)
8) Keramas, James G. (1998), " Robot Technology Fundamentals", ISBN: 981-240-621-2 (CENGAGE)

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ELECTIVE-I1: 7. COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objective:

To understand the concepts of computer integrated manufacturing system and its applications.

Course Outcome:

The student shall demonstrate the knowledge of the concepts of computer integrated manufacturing system and its applications.

Unit-1

Basic Concept of CIMS,:-Scope, islands of automation, architecture of CIM, information flow in CIM, elements of CIM, benefits, limitations, obstacles in implementation Planning for CIMS, need for planning, Phases of CIM implementation, incremental implementation and one time implementation,

CIM benchmarking, Economic and social justification of CIM. (6)

Unit-2

Product Design and CAD, application of computers in design, CAM – manufacturing planning and control, scope of CAD / CAM and CIM, Concurrent engineering, Design for manufacturing and assembly ,Case studies on Concurrent engineering, Design for manufacturing and assembly. (6)

Unit-3

a) Group Technology: Concept, design and manufacturing attributes, part families, composite part, methods of grouping, PFA, classification and coding system- OPITZ, Relevance of GT in CIM, GT and CAD, benefits and limitations of GT. (3)

b) Computer Aided Process Planning and Control: need, retrieval and generative type CAPP, role of CAPP in CIM. (2)

c) Computer Aided Production Planning and Control: Computer integrated production management system, Role of computers in aggregate planning, master production schedule, shop floor control, materials requirement planning, and capacity planning, manufacturing resource planning and enterprise resource planning (3)

Unit-4

Flexible Manufacturing Systems, Transfer lines, Assembly Lines in CIMS: Concept, flexible & rigid manufacturing, manufacturing cell and FMS structure, types, components of FMS, Distributed Numerical Control (DNC), Building Blocks of FMS, Flexible Assembly System, Transfer Lines, concept, applications, benefits, Automates assembly lines, Design for assembly. (6)

Unit-5

Production Support Machines and Systems in CIM: Robots, types, joint configurations, Industrial robots for load/unload, automated material handling, automatic guided vehicles, Types, Vehicle guidance, Management and safety, automated storage and retrieval system. (6)

Unit-6

a) Data Acquisition and Database Management Systems: (a) Data acquisition system, type of data, automatic data identification methods, bar code technology, machine vision.(b) Data and database management system, database design requirements, types of DBMS models- hierarchical, network and relational models and their applications (4)

b) Communication in CIMS: Role of communication in CIMS, requirements of shop floor communication, types and components of communication systems in CIM, Networking concepts, network topology, access methods, ISO-OSI reference model for protocols, MAP/TOP, TCP/IP. (4)

Term work:

1) Exercise on classification and coding of components using GT Techniques, related toa) Design Attributes, b) Manufacturing attributes.
2) Exercise on building MRP system for a company manufacturing approximately 3 – 5assembly products involving total about 15 components.
3) Exercise on capacity planning for a turning shop with 5 – 10 lathes, 15 turnedcomponents with average 3 to 4 turning operations each, for given batch sizes.
4) Study of co-ordinate measuring machine involving study of dimensions andgeometrical features of components, accessories of C.M.M.s and programming aspects,through an industrial visit and its report
5) Exercise on Database Management- Creation of a simple manufacturing database usingMS Access or similar software involving query, sorting.
6) Case study on data acquisition systems, LAN structure & communication interface.

Reference Books:

1) Automation, Production systems and Computer Integrated Manufacturing, 3/e - M.PGroover (PHI or Pearson Education)
2) Computer Integrated Design and Manufacturing - Bedworth, Henderson & Wolfe,(McGraw Hill)
3) Performance Modeling of Automated Manufacturing Systems, 2/e - Viswanadham, N&Narahari, Y. (EEE) (PHI)
4) Principles of Computer Integrated Manufacturing - S. Kant Vajpayee, (PHI)
5) CAD / CAM Principles and Applications - P.N. Rao (Tata McGraw Hill)
6) CIM Handbook - Teicholtz& Orr (McGraw Hill)
7) CAD/CAM/CIM, 3/e – Radhakrishnan, Subramanayam&Raju (New Age International)
8) Computer Integrated Manufacturing, 2/e - James A. Rehg, H. W. Kraebber, (PearsonEducation)
9) MAP/TOP Networking : Foundation of CIM – Vincent Jones (McGraw Hill)

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Elective-III: 1. MARKETING MANAGEMENT

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objective:
Study of fundamentals of marketing and its commercial and technical application.

Corse Outcomes:
The students shall be able to demonstrate the knowledge of fundamentals of marketing and its commercial and technical application

Unit-1
Introduction: Meaning, scope, needs and importance of marketing, difference between marketing and selling, concept of market, types of markets, marketing concepts and tools, concept of societal marketing, marketing strategies, impact of Multi National Corporations, privatization etc. Ecommerce/ On line marketing. (5)

Unit-2
Buying Behavior of Organizational and Consumer Buyers: Factors influencing buying process analysis of behavior. (3)

Marketing Planning: Meaning and importance, marketing strategies, sales forecasting, methods of sales forecasting, marketing budget and marketing organization, data banks utilization (3)
Market Segmentation: Meaning, bases for segmenting consumer markets, market coverage strategies adopted for segmenting the market, aggregation strategy, single segment strategy and multiple segment strategy. (3)

Unit-3
Marketing Information systems [MIS]: Marketing research marketing research procedure, the order – shipping - billing cycle, the system of sales reporting, computer integration. (5)

Unit-4

I) Marketing Mix: Introduction to marketing Mix elements - product, place, promotion and rice

a] Product [Goods and Services]: Concept of product, classification of consumer goods, convenience goods, shopping goods and specialty goods, product life cycle, product mix, product decisions to be made such as brand policy decisions, product modification decisions, product elimination decisions, new product development decisions and product mix decisions, procedure for new product development.

b] Place: Channels of distribution, meaning, types of channels, selecting the type of a channel, channel management, physical distribution wholesaling and retailing.

c] Promotion: An introduction to promotion-mix elements, advertising, personal selling, sales promotion and publicity

d] Pricing: Meaning and importance of price, pricing objectives, procedure for setting the base price, price modification and price negotiation (8)

II) Advertising: Objectives, types of advertisements, developing advertising campaign, deciding on advertising media, sales promotion and publicity, ethics, regulations for advertising. (2)

Unit-5

Sales Management: Meaning and its role in marketing function responsibilities of sales department, personal selling, sales force, designing a sales force, recruiting and selecting a sales force, training and remuneration of sales force, sales territories, sales quotas, performance evaluation of sales staff, salesmanship (4)

Ubit-6

Industrial Marketing: MNCs, other major participants, cultural environment, attitudes, practices, ethics, monetary system; Export marketing – need, information, database and legislation (3)

Term Work:

Any five exercises to be conducted based on topics below (Sr. No. 6 compulsory).

1. Survey of Buyers.
    - Questionnaire Preparation – product / service
    - Obtaining the feedback
    - Analysis
2. Case study based on selection of product / service and its technical study from various competitors available nearby.
3. Development of market segmentation strategy for a product of a company.
4. New product development based on survey of 10-15 potential buyers.
5. Case study based on (any one)
    - Distribution network of a company
    - Developing an Advertising campaign for a product.
6. Group discussion on any one of the above topic (each group of about 8 students).

Reference Books:

1. Kotler, Armstrong, “Principles of Marketing”, 10/e, Pearson Education
2. Philip Kotler, “Marketing Management”, Prentice-Hall of India.
3. J.C.Gandhi, “Marketing- A Managerial Introduction”, TMH
4. David Luck et al, “Marketing Research”, TMH
5. Mahendra Mohan, “Advertising Management” TMH.
6. James S. Norris, “Advertising”, Prentice-Hall of India.
7. B. Horvard Levy, “ Marketing made simple”, Rupa Paperback on Business Management
8. J.C.Gandhi, “ Principles of Marketing and Salesmanship”
9. Hill,“ Industrial Marketing”

10. S.A.Sherlekar,"Marketing Management"
11. Ramswami and Namkumari, "Marketing Management"
12. Stanton, Etzel, Walker, "Fundamentals of Marketing", McGraw Hill
13. P. J. Joshef, "E – Commerce", PHI

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Elective-III: 2. STATISTICS FOR ENGINEERING RESEARCH

Teaching Scheme:	**Examination scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hrs. / Week/ Batch	Term work: 25 Marks

Course Objective :
To study the fundamental concepts and methodology of statistics with reference to its application in engineering research.

Course Outcome :
The students shall have the knowledge of fundamental concepts and methodology of statistics with reference to its application in engineering research.

Unit-1
Research Methodology: Introduction. The Design of Research, Meaning, Need, Dimensions and Process, Types of research design, Hypothesis Testing: Sampling theory; Formulation of Hypotheses, Sampling Techniques- Simple random sampling, systematic, Stratified, Multistage, Cluster sampling, Designing and Methodology of an experiment. Introduction: Measures of Location: Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode and simple properties. Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Variance, Standard Deviation, Coefficient of Variation. (6)

Unit-2
Probability: Statistical Probability with simple problems. Conditional probability. Baye's Theorem. (5)

Unit-3
Test of Significance: Sampling distribution of mean and standard error, Large sample tests- Z- Test for an assumed mean and equality of two population means, Small sample tests, t-test for an assumed mean and equality of means of two populations, Paired t-test. Confidence Interval for means. (8)

Unit-4
Correlation and Regression: Bi-variate data, Simple correlation and Regression coefficients and their relation. Linear regression and equations of line of regression. Curve Fitting. (5)

Unit-5
Test using Chi-square Distribution: Inference about population variance (F test). Goodness of fit test. Test for independence of attributes Yates's Correction. Confidence Interval for variances. (5)

Unit-6

Experimental Design: Principles of experimental designs, completely randomized design. Randomized block design and precision of results. Simple factorial Experiments of 2^2, 2^3. Analysis of variance (ANOVA) and its uses in the designs. (8)

Term Work:

Total Six assignments based on each of the six units of the above syllabus, including quantitative assignments on data analysis, hypothesis testing, and analysis of variance using suitable statistical analysis software.

Reference Books:

1) Fundamentals of Mathematical Statistics - Gupta V.K. & Kapoor S.C..- S. Chand Publicatons.
2) Design and Analysis of Experiments, Montgomery, D.C.: Wiley Eastern Ltd., New Delhi.
3) Statistical Methods, S P Gupta, Sultan Chand & Sons, Latest edn
4) Statistics for Management- T. N. Srivastava, Sailaja Rego, Tata McGraw Hill Publications.
5) Fundamentals of Business Statistics, 2nd Edition, J. K. Sharma, Vikas Publication, 2014.
6) Research Methodology- Methods and Techniques, Kothari, C.K., (2004), 2/e, (New Age International, New Delhi)
7) Research Methodology, Panneerselvam, PHI, ISBN: 81-203-2452-8

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Elective-III: 3. MATERIALS MANAGEMENT

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hrs. / Week/ Batch	Term work: 25 Marks

Course Objective:

Study of fundamental concepts and applications of various techniques of Materials Management in practice.

Course Outcomes:

The students shall have the knowledge of various concepts and application of different techniques of materials management.

Unit-1

Introduction: integrated materials management concept. Objectives, organizational structure, material cycle, Make or Buy Decision- factors, financial and manufacturing aspects (4)

Unit-2

Materials Forecasting: general economic forecast, major cyclical indicators, forecasting the price, materials requirement planning.(MRP) Purchasing- Functions, Procedures, Documents used as per ISO 9001, Policies, Types of purchasing - hand to mouth, forward buying, speculative buying, commodity markets, price -cost analysis, negotiations (8)

Unit-3
Selection of sources of supply, Vendor evaluation and rating, Vendor development. Purchase research**,** value analysis, introduction to legal aspects of purchasing. (7)

Unit-4
Inventory Management: Basic concepts, Need, Deterministic and Probabilistic EOQ models, Inventory costs, Selective Inventory control techniques- ABC and VED analysis, Fixed quantity, Periodic review system, Spare Parts Inventory Management, safety stock determination (7)

Unit-5
Stores Management: Objectives, stores layout, storage system and equipment, automated storage and retrieval system, Procedures & Documents as per ISO9001, material classification and codification as per ISO 9001, materials accounting system. (6)

Unit-6
Recent Trends In Inventory Management: Zero inventory, JIT concept and tools, Management performance evaluation, information systems and computers applications in materials management, ERP module of MM. (4)

Term Work:
The term work shall consist of any Six assignments based on following topics.
(At least one exercise based on computers)
1. Case study on Make or Buy decision
2. Study of Material cycle, documents as per ISO / QS 9000.
3. Case study on Vendor Rating
4. Case study on fixed period orders and fixed quantity inventory system with safety stock analysis
5. Exercise on MRP for a system with 2 to 3 product assemblies, each having about five components
6. Exercises on probabilistic EOQ models
7. Study of materials classification and codification

Reference Books:

1. Materials Management - Dean S. Ammer (Taraporwalla & Sons)
2. Purchasing Management- J.H. Westing, I.V. Fine C.J. Zenc (John Wiley and Sons)
3. Purchasing & Materials Management - Lamer Lee Jr... Donad W. Dobler (TMH)
4. Integrated Materials Management- A. K. Dutta (S. Chand & Co.)
5. Stores House and Stock management - H. K. Comption (Business Books Ltd.)
6. Storage Controls & Stocks - Alex Morrison (ELBS)
7. Purchasing and Materials Management- P. Gopalkrishnan (TMH)
8. Materials Management - A. K. Dutta (PHI)
9. Stores Management – K.S.Menon (MACMILLAN)

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Elective-III: 4. PROJECT MANAGEMENT

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Corse Objective:
To study the fundamental concepts, tools and techniques of Project Management & its applications.

Course Outcome:
The students shall demonstrate the knowledge of the fundamental concepts, tools and techniques of Project Management & its applications.

Unit-1
Introduction to Project:
Definition of a Project, Types, Sequence of Activities, Unique activities, Complex Activities, Connected Activities, One Goal, Specified Time, Within Budget, According to Specification. Defining a Program, Project parameters: Scope, Quality, Cost, Time, Resources; The scope triangle: Time, Cost, and Resource Availability, Project Classification. (3)

Unit -2
Project Management:
Principles of Project Management: Defining, Planning, Executing, Controlling, Closing; Project Management Life Cycle: Phases of Project Management, Levels of Project Management; Quality Management: Continuous Quality Management Model, Process Quality Management Model; Risk Management, Risk Analysis; Relationship between Project Management and other Methodologies. (6)

Unit-3
Project Activities:
Work Breakdown Structure, Uses of WBS, Generating the WBS: Top-Down/ Bottom-Up Approach, WBS for Small Projects, Intermediate WBS for large projects; Criteria to Test for Completeness in the WBS: Measurable Status, Bounded, Deliverable, Cost/Time Estimate, Acceptable Duration Limits, Activity Independence; Approaches to Building the WBS: various approaches, Representing WBS. **Activity Duration, Resource Requirements, & Cost:** Duration: Resource Loading versus Activity Duration, Variation in Activity Duration, Methods for Estimating Activity Duration, Estimation Precision; Resources; Estimating Cost, JPP Session to Estimate Activity Duration & Resource Requirements, Determining Resource Requirements. (8)

Unit-4
Fundamentals of Project Network Diagram:
Project Network Diagram, Benefits to Network- Based Scheduling, Building the Network Diagram Using the PDM, Analyzing the Initial Project Network Diagram.

Network Analysis – PERT:
Introduction to Project Evaluation and Review Technique, Event, Activity, Dummy, Network rules, Graphical guidelines for network, Common partial situations in network, numbering the events, Cycles; Developing the Network, Planning for network construction, modes of network construction, steps in developing network, hierarchies; Time Estimates in PERT, Uncertainties and use of PERT, Time estimates, Frequency distribution, Mean, Variance & standard deviation, Probability distribution, Beta distribution, Expected time; Time Computations in PERT, Earliest expected time, Formulation for TE,

Latest allowable occurrence time, Formulation for TL, Combined tabular computations for TE, TL; Slack, Critical Path, Probability of meeting schedule date. (9)

Unit-5

Network Analysis- CPM:

Introduction to Critical Path Method, Procedure, Networks, Activity time estimate, Earliest event time, Latest allowable occurrence time, Combined tabular computations for TE and TL, Start & Finish times of activity, Float, Critical activities & Critical path. Crashing of project network, Resource leveling and Resource allocation. (8)

Unit-6

Schedules Based on Resource Availability:

Resources, Leveling Resources, Acceptability Leveled Schedule, Resource Leveling Strategies, Work Packages: Purpose of a Work Package, Format of a Work Package. (6)

Term Work:

Term work shall consist of at least six assignments based on above units. At least one assignment shall be based on computer application for project management using suitable software.

References Books:

1) Prasanna Chandra, "Projects – Planning, Analysis, Financing, Implementation and Review", Tata McGraw Hill,4th Ed, 1997
2) Mike Field and Laurie Keller, "Project Management", Thompson Business press, 2002
3) Gido and Clements, "Successful project management", 2nd edition; Thompson south-western, 2003
4) John M Nicholas, "Project Management for business and technology", 2nd edition, Pearson Education Asia, 2001
5) Bhavesh M Patel, "Project Management – Strategic Financial planning, Evaluation and control", Vikas publishing house, 2000
6) S.Choudry "Project Management", Tata McGraw Hill,27th edition, 2006
7) Effective Project Management Robert K. Wysocki, Robert Beck. Jr., and David B. Crane; - John Wiley & Sons.
8) Project Planning and Control with CPM and PERT- Dr. B.C. Punamia & K.K.Khandelwal; - Laxmi Publications, New Delhi.
9) Project Management- S. Choudhury, - TMH Publishing Co. Ltd, New Delhi
10) Total Project Management- The Indian Context- P. K. Joy, - Macmillan India Ltd., Delhi
11) Project Management in Manufacturing and High Technology Operations- Adedeji Bodunde Badiru, - John Wiley and Sons.
12) Course in PERT & CPM- R.C.Gupta, - DhanpatRai and Sons, New Delhi
13) Fundamentals of PERT/ CPM and Project Management- S.K. Bhattacharjee; - Khanna Publishers, New Delhi

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Elective-III: 5. FINANCIAL MANAGEMENT

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objective:
To study the basic concepts of financial management applied to manufacturing industry.

Course Outcome:
The students shall be able to demonstrate the knowledge of financial management as applied in the manufacturing industry.

Unit-1
Finance Function and Sources of Finance: - Objectives of Financial management, finance Functions, Internal and External, Short, medium, and long term finance (6)

Unit-2
Management Accounting: Types of financial statements, Interpretation of financial statements using Ratio Analysis, cost volume profit analysis, Working capital management. (8)

Unit-3
Financial structure, cost and financing decisions: - Planning capital structure, Debt – Equity Ratio and financing, cost of capital, concept of operating and financial leverage, capital budgeting – Nature and significance .Techniques of capital budgeting. (6)

Unit-4
Project Planning: - Generation and screening of project ideas market and demand analysis, technical analysis financial estimates and projection. (4)

Unit-5
Marketing of Securities and Dividend Policies: - Underwriting, role of stock exchange, functions, operations, government regulations of stock exchanges in India, Issue of bonus shares, Right issue, Dividend policies, determinants of dividend policies, concept of portfolio analysis. (8)

Unit-6
Budgeting and budgetary control: Meaning of budget, budgetary control, budgeting, essentials of effective budgeting, advantages and limitations, classification, flexible budget, cash budget, sales budget. (8)

Note: - Numerical Treatment is expected for the following topics:
1. Ratio Analysis.
2. Cost volume profit analysis
3. Capital Budgeting
4. Cost of Capital
5. Working Capital
6. Budgeting: a) Flexible Budgeting b) Cash Budget c) Sales Budget

Term Work:
1. One assignment on Finance Function to be studied by visiting a local industrial organization.
2. Numerical exercises on the areas mentioned above
3. Two case studies on industrial financing

Reference Books:
1. Financial Management- I.M Pandey. Vikas Publishing House Pvt Ltd.
2. Management Accounting & Financial Management – R.K.Sharma & Shashi K. Gupta–Kalyani Publishers.
3. Project Planning, Analysis, Selection, Implementation & Review. - Prasanna Chandra-Tata Mac

Grew Hill Publishers.
4. Financial Management- P.V. Konkani &B.G Sashay Prasad – Himalaya Publishing House.
5. Management Accounting- R S.N Pillai, Bagavathi – S.Chand & Company Ltd.
6. Corporate Finance – S. C. Kuchhal & Suchitra Mittal (Chaitanya Publication House)
7. Financial, Cost and Management Accounting – Dr. P. Periasamy, Himalaya Publishing House.
8. Financial Management – Dr. P. Periasamy, Himalaya TMH.

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Elective-III: 6. ENTREPRENEURSHIP DEVELOPMENT

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hr. / Week/ Batch	Term work: 25 Marks

Course Objective:
To familiarize students with fundamentals of Entrepreneurship and to encourage them to become successful entrepreneurs.

Course Outcomes:
The students shall demonstrate the knowledge of Entrepreneurship and shall be motivated to become successful entrepreneurs.

Unit - 1
Entrepreneurship: Definition of Entrepreneur and Entrepreneurship, entrepreneurial process, Entrepreneurship and economic development, job creation, Indian scene.
Entrepreneurial Motivation: Self-disclosure, personality effectiveness, risk taking, entrepreneurial competencies, case studies. (3)

Unit - 2
Small Scale Units: Concept and definition, role of S.S.I. in Indian economy, government policies and facilities.
Planning Small Scale Business: Business opportunity identification, idea generation, ideas from marketplace, market assessment, demand estimation.
Small Business Management: Techniques of marketing, materials, production, manpower and financial management, crisis management, working capital management, fixed capital assessment, cash flow analysis, ROI, techniques of decision making.
Demand Analysis: Demand Theory and Analysis – Individual demand and Market demand – Factors determining demand – Elasticity of demand – Price Elasticity - Income Elasticity – Cross Elasticity – Elasticity and Decision – making (Analytical problems). Demand estimation: Linear regression, Interpreting coefficients, Interpreting regression fit, Omitted variables, Log linear estimation. Consumers Equilibrium, Cardinal utility approach, Indifference curve approach, Theory of revealed preference, Consumer surplus (8)

Unit - 3
Managerial Economics: Introduction to Economics, Kinds of Economic Decisions, Significance and applicability of Managerial Economics in decision making, Role and responsibilities of Managerial Economics, Economic principles relevant to managerial decision making, Opportunity cost, Production

possibility curve, Concept of increments and Margin, Discounting principle. (Numerical Problems)

Business Accounting: Study of Balance sheets, Profit and Loss statements. Need, format of Trading and Profit and Loss A/c., Items to be recorded on the Debit and Credit Side of Trading and Profit and Loss A/c, Preparation of Trading and Profit and Loss A/c. Need, format of Balance Sheet, identification of Accounts to be written on liabilities and Assets side, Preparation of Balance sheet. (Analytical Problems) (9)

Unit – 4

Government Support Organizations:

The detailed study of the government support system for the entrepreneurship development.

a) Central Government
b) State government
c) Financial support organizations
d) Government schemes and procedures (6)

Unit - 5

Business plan preparation: Meaning of business plan, project parameters, information sources of economical and technical knowhow, selection of location, identification of raw material, suppliers, plants/machinery, process, manpower and other inputs such as power, water etc. Preparation of project report including the following aspects. Analytical calculations for decision making at each of the following shall be included.-

1) Selection of product.
2) Process and plant and machinery selection.
3) Site selection and Plant Layout planning.
4) Financial viability analysis.
5) Marketing and distribution of goods.
6) Study of probable reasons of failure. (8)

Unit - 6

Statutory Requirements: Factories Act 1948, Industrial disputes Act 1947, Indian Contract Act, Indian sales and Goods Act, Indian Partnership Act, Central Excise, Sales tax, Income Tax Act, Value Added Tax (VAT).

Business Aspects: Business ethics, export environment, procedure and documentation, venture capital financing, intellectual property act, patents, GATT. (6)

Term Work:

Minimum Six exercises / case studies based on the topics below. Assignment No. 2, 4 & 6 shall include the analytical problems.

1. Study of Government policies and procedures to start SSI.
2. Study of Calculations of working capital requirements.
3. Study of resources and procedures to get financial assistance.
4. Study of tax procedures.
5. Study of export procedures.
6. Study & Preparation of project feasibility report for the manufacturing of a product.

Reference Books:

1. Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.
2. Handbook of New Entrepreneurs
3. Management of Small Scale Industry - Vasant Desai (Himalaya Publication)
4. Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)

5. Motivating Economic Achievement- David C. McClelland, David G. Winter
6. Industrial Maharashtra- Facts, Figures and Opportunities (M.I.D.C. Mumbai).
7. Project Planning & Entrepreneurship Development - T. R. Banga
8. Dynamics of Entrepreneurial Development & Management- Vasant Desai (Himalaya Publication)
9. S.S.I. and Entrepreneurship- Vasant Desai (Himalaya Publication)
10. Petersen and Lewis : Managerial Economics, 4/e, Pearson/PHI, 2002. 2. Managerial Economics, Ahuja. H.L, S. Chand, New Delhi.
11. M.L. Trivedi: Managerial Economics, Tata Mc-Graw Hill, New Delhi 2004.
12. PindyckRubinfeld& Mehta, "Micro Economics", Pearson
13. Ramachandran, and Kakani, "How to Analyze Financial Statements", Tata McGraw Hill
14. Palat, Raghu, "How to Read Annual Reports and Balance Sheets", JAICO Publishing House
15. Dash A.P., "Financial Wisdom – Finance for Non-Finance Executives", Biztantra ISBN 978-81-7722-378-1

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Elective-III: 7. SUPPLY CHAIN MANAGEMENT

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 2 Hrs. / Week/ Batch	Term work: 25 Marks

Course Objective:
To study the fundamentals and applications of various techniques of Supply Chain Management in practice.

Course Outcome:
The students shall have the knowledge of the fundamentals and applications of various techniques of Supply Chain Management in practice.

Unit-1:
Introduction to Supply Chain Management: Building a Strategic framework to Analyze Supply Chains: Understanding the supply chain, supply chain performance, Supply chain drivers & obstacles.(5)

Unit-2:
Planning Demand & Supply in Supply Chains: Demand forecasting in supply chain, aggregate planning in supply chain, planning demand & supply in supply chains. (6)

Unit-3:
Planning & Managing Inventories in a Supply in Supply chains: Managing economies of scale in a supply chain: cycle inventory, managing uncertainty in supply chain: safety inventory, determining optimal level of product availability. (6)

Unit-4:

Design consideration in Supply Chain: Transportation, Network Design, & Information technology in a supply chain: Transportation in supply chain, facility decisions: network design in a supply chain, information technology in a supply chain. (7)

Unit-5:

Supply Chain Coordination Logistics in SCM: Coordinating in a Supply Chain & role of E-Business: Coordination in a supply chain, E- business & the supply chain.

Logistics In Supply Chain Management: Introduction, Strategy, Transportation Selection, Trade-off, Models for Transportation and Distribution, Third Party Logistics,, Overview of Indian Infrastructure for Transportation. (7)

Unit-6:

Financial consideration in Supply Chain: Financial factors Influencing Supply Chain Decisions: Financial evaluation of supply chain decisions, the impact of financial factors on supply chain decisions, evaluating supply chain decisions using decision trees, (6)

Term Work:

Any six assignments based on the above syllabus (One from each unit)

Text Books:

1. Sunil Chopra & Peter Meindl, "Supply Chain Management: Strategy, Planning, & Operation", Addison Wesley Long man.
2. A. J. Vanweela, "Purchasing & Supply Chain Management"Cengage learning(Nov2004) ISBN 1844800245

Reference Books:

1. R.H. Ballou, "Supply Chain Management" Pearson[2007] ISBN 8131705846 B. E. Production Engineering – S / W - 2008 Proposed Syllabus Page 36 of 42
2. Simchi-Levi, Kaminsky, "Designing and Managing the Supply Chain, Concepts Strategies and Case Studies", 2nd edition, Tata McGraw Hill, ISBN 0-07-058666-7
3. R. Monczka, "Purchasing & Supply Chain Management" Cengage learning business Press.,ISBN 140801744X

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6. PROJECT WORK- Phase II

Teaching Scheme:
Practical: 4 Hrs. / Week/ Batch

Examination Scheme:
Term work: 75 Marks
Oral Examination: 50 Marks

Course Objective:
To prepare the students to carry out a comprehensive study of any design or process or phenomenon, to encourage the process of independent creative thinking and working in groups and to expose them to industrial atmosphere of accountability.

Course Outcomes:
The students shall have the ability to carry out a comprehensive study of any design or process or phenomenon as well as independent creative thinking and working in groups with exposure to industrial atmosphere of accountability.

Term Work:
The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The work started in Semester VII will be continued in the Semester VIII and the final submission of the report will be at the end of the Semester VIII.

The project work may consist of-
1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing it.
4. Experimental verification of principles used in applications related to Production or Mechanical Engineering.
5. A combination of the above.

A synopsis of the selected project work (two to three pages typed on A4 size sheets) will be submitted and assessed by the Project Guide and one more faculty member appointed by the Department / concerned responsible official of the sponsoring industry (Co-guide).

The work to be completed in Semester VII shall include-
a) Problem Identification
b) Methodology / Design Documents
c) Activity planning for the time frame and **division of responsibility to each student**. An interim report of the work completed in Semester VII in the form of workbook /project diary and other relevant documents shall be submitted for the term work. The term work shall be assessed by the Guide and one more faculty member appointed by the Head of the Department. The assessment shall be based on a presentation of the work completed and submission of interim report.
The oral examination shall be based on the work planned and actually completed in Semester-VII.