Savitribai Phule Pune University

Faculty of Engineering

Board of Production and Industrial Engineering

B. E. (Production Engineering) Syllabus

(2012 Course)

Production Engineering

COURSE STRUCTURE FOR

BE (Production Engineering) (2012 Course)

SEMESTER- I

Subject Code	Subject	Teaching Scheme (Hrs/week)			Examination Scheme				
		Lect	Tut	PR	In-Semester Assessment	PR/TW	OR/TW	End Semester Exam	Total Marks
411081	Machine tool Design	3			30			70	100
411082	Automation and control Engineering	3			30			70	100
411083	Operations Research	4			30			70	100
411084	Elective I	3			30			70	100
411085	Elective II	3			30			70	100
411086	Machine Tool Design			2			50 (OR)		50
411087	Automation and Control Engineering			2		50(PR)			50
411088	Operations Research			2		50 (TW)			50
411089	Elective II			2			50(TW)		50
411090	Project Phase 1		2			50 (TW)			50
	Total	**16**	**2**	**8**	**150**	**150**	**100**	**350**	**750**

Lect: Lectures Tut: Tutorial PR: Practical TW: Term Work OR: Oral

Elective I

(a) Human Factors in Engineering and Ergonomics

(b) Financial Management and Costing

(c) Reliability Engineering

(d) Energy Management

Elective II

(a) Advanced Welding

(b) Materials Technology

(c) Surface Engineering

(d) Intelligent Manufacturing Systems

SEMESTER –II

Subject Code	Subject	Teaching Scheme (Hrs/week)			Examination Scheme				
		Lect	Tut	PR	In-Semester Assessment	PR/TW	OR/TW	End Semester Exam	Total Marks
411091	Computer Integrated Design & Manufacturing	3			30			70	100
411092	Product Design and Development	3			30			70	100
411093	Elective III	3			30			70	100
411094	Elective IV	3			30			70	100
411095	Computer Integrated Design & Manufacturing			2		50 (PR)			50
411096	Product Design and Development			2			50 (OR)		50
411097	Elective III			2			50(TW)		50
411098	Elective IV			2		50 (TW)			50
411099	Project Work		6			50 (TW)	100 (OR)		150
Total		**12**	**6**	**8**	**120**	**150**	**200**	**280**	**750**

Lect: Lectures Tut: Tutorial PR: Practical TW: Term Work OR: Oral

Elective III

(a) Materials and Logistic Management

(b) Finite element analysis

(c) World Class Manufacturing

(d) Industrial Relations and Human Resources

Elective IV

(a) Industrial Robotics

(b) Simulation and Modeling

(c) Automobile Engineering

(d) Mechatronics

411081

MACHINE TOOL DESIGN

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Drives **[7]**

Design considerations for drives based on continuous and intermittent requirement of power, Types and selection of motor for the drive, Regulation and range of speed based on preferred number series, geometric progression. Design of speed gear box for spindle drive and feed gear box.

Unit II: Design of Machine Tool Structures **[7]**

Analysis of forces on machine tool structure, static and dynamic stiffness. Design of beds, columns, housings, bases and tables.

Unit III: Design of Guide ways **[7]**

Functions and types of guide ways, design criteria and calculation for slide ways, design of hydrodynamic, hydrostatic and aerostatic slide ways, Stick-Slip motion in slide ways.

Unit IV: Design of Spindles, Spindle Supports and Power Screws **[7]**

Design of spindle and spindle support using deflection and rigidity analysis, analysis of antifriction bearings, preloading of antifriction bearing. Design of power screws: Distribution of load and rigidity analysis.

Unit V: Dynamics of machine tools **[7]**

Dynamic characteristic of the cutting process, Stability analysis, vibrations of machine tools.

Control Systems: Mechanical and Electrical, Adaptive Control System, relays, push button control, electrical brakes, drum control.

Unit VI: Special Features of Machine Tools **[7]**

Design considerations of Stepless drives, electromechanical system of regulation, friction, and ball variators, PIV drive, Epicyclic drive, principle of self locking.

Design considerations for SPM, NC/CNC, and micro machining, Retrofitting, Recent trends in machine tools, Design Layout of machine tool using matrices.

References:

1. Mehta N.K., “Machine Tool Design”, Tata McGraw Hill, ISBN 0-07-451775-9.
2. Bhattacharya A. and Sen S.G., “Principles of Machine Tool”, New central book agency Calcutta, ISBN 81-7381-1555.
3. Pal D.K., Basu S.K., “Design of Machine Tool”, 4th Edition. Oxford IBH 2005, ISBN:81204-0968.
4. Date P. P., “Introduction to Manufacturing Technology, Principles and Practices”, , Jayco Publishers, Mumbai
5. Koenigsberger F., “Design Principles of Metal Cutting Machine Tools”, The Macmillan Company, New York 1964.

AUTOMATION AND CONTROL ENGINEERING

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Basics of Automation **[6]**

Definition, concepts, types of automation, low/medium/high cost, hard/flexible automation, semi/fully automation in machine tools, job/material transfer devices Introduction to automated material handling and storage-ASRS,AGV.

Unit II: Hydraulic fluid power automation **[6]**

Advantages of hydraulic fluid power automation, operational principles and uses of hydraulic power system, functioning of hydraulic components such as pumps, filters, control devices, linear and rotary actuators, hydraulic control for industrial application, design and development of hydraulic circuits for simple application areas involving selection of hydraulic components for specific applications, electro hydraulic principles and components used in electro-hydraulic, industrial applications based on electro hydraulic, proportional valves and activation technology, industrial applications with proportional valves.

Unit III: Pneumatic Systems **[6]**

Operational principles and application, air compressors, Pneumatic cylinders and air motors, Pneumatic valves, functions of different pneumatic components and selection, construction of pneumatic controls and circuit diagrams for conveying, feeding, clamping, indexing, cutting and non-cutting operations.

Unit IV: Programmable Automation **[6]**

Introduction to microprocessor, Microcontroller, Microcontroller based manufacturing systems, Logic gate and control, Computer process controls - any manufacturing case study.

Unit V: Control System **[6]**

Data conversion (ADC/DAC), Programmable logic controller, Interfacing circuits, Actuating signals, relays, contactors, Types of control systems- P, PI, PID , Optimal control system.

Unit VI: Automated Assembly, And Shop Floor Control **[6]**

Automated assembly – Fundamental – system configuration, part delivery at work station – Design for automated assembly Computer process control – continuous, discrete process, control requirement, capabilities, Shop floor control – Three phases – Factory data collection – manual method – Automated and semi automated data collection (ADC) – Bar code technologies and other ADC Technologies.

Oral shall be based on the above term work and practical.

Text Books:

1. Kuo B.C., “Automatic control systems”, Prentice Hall India Pvt. Ltd., New Delhi

2. Peter Rohner, “Industrial hydraulic control”, Wiley Edition, 1995
3. Mikell P Groover, “Automation, Production System and Computer Integrated Manufacturing”,Prentice Hall Publications, ISBN 81-203-0618-X.
4. Mujumdar S.R., “Pneumatic System”, Tata McGraw Hill, 2002 Edition.
5. Gopal, “Control Systems Engineering”, Willey Eastern Ltd., ISBN 0-85226-605-7.

Reference Books:

1. Doebelin E.O, “Measurement System, Application and Design”, Tata McGraw Hill Publications Ltd., New Delhi, ISBN 0-07—17338-9.
2. Bolton W., “Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering”, Pearson Education (Singapore) Pvt Ltd., ISBN 81-7808-339-6.
3. Rangan C.S., Sharma G.R., Mani V.S., “Instrumentation - Devices and Systems”, Tata McGraw Hill Publications Ltd., New Delhi, ISBN 0-07-463350-3.
4. Histand B.H., Alciatore D.G., “Introduction to Mechatronics and Measurement Systems”, ISBN 0-07-052910-8.
5. Johnson C.D., “Process Control Instrumentation Technology”, Prentice Hall of India Pvt.Ltd., New Delhi, ISBN 81-203-0987-1.
6. HMT Mechatronics, HMT, ISBN 0-07-462147-5..
7. Vickers manual on hydraulics
8. G. Boothroyd , C. Poli, L. Murch, “Automatic Assembly”, Marcel Dekker Inc. 1982.
9. Werner Deport and Kurt Stool, "Mechanization by pneumatic control", Vol. I and II.
10. Date P. P., “Introduction to Manufacturing Technology, Principles and Practices”, Jayco Publishers, Mumbai

411083

OPERATIONS RESEARCH

Teaching Scheme **Examination Scheme**

Lectures: 4 hrs/week

In semester: 30 Marks
End semester: 70 Marks

Unit I: Linear programming (LP) **[10]**

Definition of Operations Research: Objectives, Simplex methods for maximization and minimization problems, Degeneracy in L.P., Duality in L. P.

Unit II: Transportation and Assignment problem **[8]**

Transportation problems- Use of various methods for solving transportation problem, Degeneracy and its solution, Transshipment problem.
Assignment problem- Solutions of various types of problems, Travelling salesman problem.

Unit III: Introduction to Integer, Dynamic and Non-linear programming **[6]**

Integer programming, Branch &Bound method,Dynamic programming introduction, application, Capital budgeting, Different problems solved by dynamic programming,

Geometric and goal programming, Definition, Introduction, Application of geometric and goal programming

Unit IV: Network modeling **[8]**

Fundamentals of CPM and PERT networks, CPM: Construction of networks, Critical paths, Forward and backward pass, Floats and their significance, Crashing for optimum and/or minimum duration and the cost, Resource allocation and leveling, PERT: Time estimates, Construction of networks, Probability of completing projects by given date.

Unit V: Replacement models and Games Theory **[8]**

Replacement of capital equipment that deteriorates with time, Time value of money: Cases in which time value of money remains same and changes with constant rates during period. Group and individual replacement.

Games Theory: Introduction, Two -person zero sum game, Minimax and maximin principle, Saddle point, Methods for solving game problems with mixed strategies, Graphical methods, Solution using LP.

Unit VI: Queuing theory and Simulation **[8]**

Operating characteristics, Poisson single and multi channel queuing system (M/M/1): (∞/∞/FCFS), (M/M/1): (∞/∞/SIRO),(M/M/1): (N/∞/FCFS), (M/M/c): (N/∞/FCFS)

Monte Carlo simulation of Production quantity, Demand, Inventory, Queuing systems, Investment decision etc.

Text Books

1. Sharma S.D., "Operations Research", KedarnathRamnath and company publications.
2. Gupta P.K., Hira D.S., "Operations Research", S Chand and Co. Ltd., New Delhi
3. Taha H.A., "Operations Research - An introduction", Prentice Hall Pvt. Ltd.
4. P. ShankaraIyer, "Operations Research"Sigma Series, Tata McGraw-Hill
5. Rao, S. S. " Engineering Optimization: Theory and Practice", John Wiley & Sons

Reference Books

1. Hillier F.S., Lieberman G.J., "Introduction to Operations Research", Tata McGraw-Hill,
2. Wagner H.M., "Principles of Operations Research", Prentice-Hall India,
3. Ravindran A., "Operations Research", Tata McGraw-Hill. New Delhi
4. Basu S.K., Pal D.K., and Bagchi H., "Operations Research for Engineers", Oxford and IBH Publishing Co. Pvt. Ltd.,
5. Panneerselvam R., "Operations Research", Prentice Hall of India Ltd., New Delhi

411084

ELECTIVE-I (A): HUMAN FACTORS IN ENGINEERING AND ERGONOMICS

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Introduction to Human Factors [8]

Human criteria's, human physical activities, features of the human body, Measures of physiological functions such as: energy expenditure, gross body activity, local muscular activity, work load, work efficiency, work and rest. Type of movements of body members. Performance criteria for physical activity such as: Strength & endurance speed of movements, accuracy of movements, manual material handling (MMH).

Unit II: Applied Anthropometry and Work Space [8]

Introduction to anthropometry, use & principles of anthropometry data, work spaces, work space envelopes for seated persons, design of work spaces such as: work surface height, seated & standing, principles of seat design, workplace design. Physical space & arrangement, principles of arrangement of component,

Unit III: Design of Displays and Controls [8]

Information input & processing, visual displays of static & dynamic information. Auditory, textual & olfactory displays general location of controls & displays within workspace, concept of visibility. Functions of controls, types of controls, factors in control design, design of specific hand operated controls, foot controls and special control devices.

Unit IV: Working Conditions [8]

Illumination: Color systems, energy consideration, effect of lighting on performance. Atmospheric conditions: Measurement of thermal variables, wet-bulb globe temperature, Botsball, heat stress index, heat index, wind chill index, physiological effect of heat & cold on performance. Noise: Physiological effect of noise on performance, noise exposure limits, noise controls.

Unit V: Energy Expenditure [8]

Muscle mechanism, BMR, Heart Rate variations, Oxygen consumption, Rest allowances, Rate of energy expenditure, Manual Material Handling Capacity determination, Effect of environmental conditions and work design on Energy Expenditure.

Unit VI: Ergonomics and Work Organization [8]

Human factors and ergonomics standards, Human factors applications in system design, characteristics of system design, human factors data for interface design, ergonomic safety and health management, case studies of ergonomically designed product.

Text Books

1. Sanders M. S. and McCormick E. J., "Human Factors in Engineering and Design", McGraw-Hill International Editions,

2. Bridger R. S., "Introduction to Ergonomics", McGraw-Hill International Editions

Reference Books:

1. Gavriel Salvendy (Ed.)., 'Handbook of human factors and ergonomics", 3rd Edition, John-Wiley and Sons

411084

ELECTIVE-I (B): FINANCIAL MANAGEMENT & COSTING

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks

End semester: 70 Marks

Unit I: Financial Management **[7]**

Financial function, Scope, goals and tools. Sources of finance, corporate planning and financial management. Financial Statements: Balance sheet, profit and loss account. Ratio Analysis: Classification, Ratio Analysis and its limitations. Operating and Financial Leverage.

Unit II: Capital Budgeting **[7]**

Control of Capital Expenditure, Evaluation Process-Payback approach, Accounting of Rate of Return, Present Value Method Vs Internal Rate of Return. Replacement cost and discounted cash flow.

Unit III: Working Capital Management **[7]**

Concept and design of Working Capital, types of working capital, sources of working capital, time value of money, cost and capital, cost of capital. Funds Flow Analysis: Concepts, Objectives, and Techniques of Funds Flow Statement.

Unit IV: Costing **[7]**

Methods of costing and elements of cost. Material Cost: Different methods of pricing of issue of materials. Material losses - Wastage and its consideration. Labour Cost: Different methods wages and incentive plans. Principles of good remunerating system, labour turnover and its methods.

Depreciation: Concept, importance and different methods of depreciation. Estimation of material, machining and labour cost machining. Overheads: Classification, collection of overheads, Primary and Secondary apportionment of overheads, absorption of overheads. Machine hour and labour hour rate. Under and over absorption of overheads. Estimation of overheads.

Unit V: Budgetary control and variance Analysis: **[7]**

Material, Labour, Overhead, Sales. Profit, Product-mix and Yield Variance. Cost control: Capital cost control-the nature of control, elements of cost control programme, project planning and scheduling, cost reporting and corrective action. Capital cost control repetitive operating cost, standard costs, cost reporting and corrective action.

Unit VI: Types of Costing Methods **[7]**

Concept, development & use of standard costing, Marginal Costing: Use of Marginal Costing in decision-making Activity based costing: Concept, cost drives, applications. Process costing: Concept, transfer cost, concept of by products, joint costing, scrap, waste, losses, cost of quality.

Text Books:

1. N. K. Prasad, "Principles and Practice of Cost Accounting", Syndicate Pvt. Ltd., Calcutta
2. M. Pandy, "Financial Management", New Delhi Vikas Publication House Pvt. Ltd., ISBN 81-259-0638-X
3. M. Y. Khan, P. K. Jain, "Financial Management", Tata McGraw Hill Publishing Ltd.
4. B. K. Bhar, "Cost Accounting Methods and Problems", Academic Publishers, Calcutta

Reference Books:

1. Henry M. Steiner, "Engineering Economics Principles", McGraw Hill Publication.
2. C.B. Gupta, "Fundamentals of Business", Sultan Chand & Co.,
3. P. A. Samualson, "Economics", McGraw Hill International.
4. K. K. Dewett, "Modem Economic Theory", Sultan Chand & Co., ISBN 81-219-0331-1
5. Colin Drury, "Management and Cost Accounting", English Language Book Society, Chapman & Hall London.

411084

ELECTIVE-I (C): RELIABILITY ENGINEERING AND TERROTECHNOLOGY

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Fundamentals of Reliability Engineering **[7]**

Reliability definition, reliability concept, quality, failure, patterns of failure, causes of failure, common distributions in failure mechanisms–experimental, weibull, gamma, normal, log normal, extreme value, model selection for components failure, failure analysis. failure density, failure rate, hazard rate, MTTF, MTBF,MTTR, MDT, unreliability, factor of safety and reliability, areas of reliability, life characteristic phases, bath-tub curve, Elements of Probability theory: Set theory, total probability theorem, bayes rule.

Unit II: System reliability and modeling: **[7]**

Series, parallel, mixed configuration, k- out of n structure, complex systems- enumeration method, conditional probability method, matrix method, cut-set and tie-set method, Redundancy, element redundancy, unit redundancy, standby redundancy- types of standby redundancy, parallel components single redundancy, multiple redundancy. Markov analysis.

Unit III: Maintainability and Availability **[7]**

Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability, system down time, Availability - Inherent, Achieved and Operational availability, reliability and maintainability trade-off.

Unit IV: System reliability Analysis **[7]**

Reliability allocation or apportionment, Reliability apportionment techniques – equal apportionment, AGREE, ARINC, feasibility of objectives apportionment, dynamic programming apportionment, Evaluation of overall system reliability, Reliability block diagrams and models, Reliability predictions from predicted unreliability, minimum effort method.

Unit V: Failure Mode, Effects and Criticality Analysis **[7]**

Failure mode effects analysis, severity/criticality analysis, FMECA examples, RPN, Ishikawa diagram for failure representation, fault tree construction, basic symbols development of functional reliability block diagram, fault tree analysis, fault tree evaluation techniques, minimal cut set method, Delphi methods, Monte carlo evaluation.

Unit VI: Reliability testing and Failure Interactions and Terro-technology **[7]**

Reliability growth models, grouped and ungrouped data, censored data, accelerated life testing, Markov analysis of two independent components, reliability with standby system, multi component systems, DTMC and CTMS models. Terro-technology, application of terro-technology.

Text Books:

1. L.S. Srinath, Concepts of Reliability Engg., Affiliated East-West Press (P) Ltd., 1985.
2. E. Balagurusmy, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1984.
3. Bhadury B., Basu S. K., "Terotechnology-Reliability Engineering and maintenance", Asian Books Private Limited, ISBN 81-86299-40-6.

Reference Books

1. A.K. Govil, "Reliability Engineering", Tata McGraw-Hill Publishing Co. Ltd., 1983.
2. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
3. M.L. Shooman, "Probabilistic Reliability", McGraw-Hill Book Co., 1968.
4. P.D.T. Conor, "Practical Reliability Engg", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons, 1977.
6. A.Birolini , "Reliability Engineering, Theory and Practice", Third Edition, Springer, 1999
7. Rao S. S., "Reliability Engineering", McGraw Hill.

411084

ELECTIVE-I (D): ENERGY MANAGEMENT

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Energy Scenario

Global primary energy reserves and consumption pattern, Indian energy scenario, sector wise energy consumption, energy needs of growing economy, energy pricing in India, energy security importance of energy conservation and introduction of energy conservation act 2001.

Unit II: Energy Economics and Energy Audit

Energy economics: Simple payback period, time value of money, return on investment, net present value and internal rate of return. Energy Audit: Methodology, analysis and reporting, portable and online instruments required for energy audit, sankey diagram and specific energy consumption.

Unit III: Thermal Systems

Boiler efficiency calculations by direct and indirect method, various losses, steam distribution nd steam traps, energy conservation opportunities in boiler. Efficiency calculation of oil fired furnace, heat losses and energy conservation opportunities in furnace. Thermal insulation, types of insulation, economic thickness of insulation.

Unit IV: Electrical Systems

Demand control, billing structure, power factor improvement, benefits and ways of improving PF, load scheduling, electric motors, losses and efficiency, energy efficient motor, speed control methods of motor, Lighting: illumination level, fixtures, timers, energy efficient illumination.

Unit IV: Energy Conservation

Energy conservation in: Compressed air systems, refrigeration and air conditioning systems, pumps, fans, D. G. set and cooling tower.

Unit VI: Cogeneration and Waste Heat Recovery

Cogeneration: Concept, technical options, classification of cogeneration system i.e. topping and bottoming cycle, selection criteria, applications. Waste Heat Recovery: Introduction, classification and applications, benefits, waste heat recovery equipments i. e. recuperator, regenerator, economizer, heat wheel, heat pipe, thermo-compressor, heat pump.

Reference Books:

1. Guide books 1, 2 and 3, Bureau of Energy Efficiency.
2. Practical Energy Audit Manual, Indo –German Energy Efficient Project, Tata Energy Research Institute (TERI).
3. Albert Thumann, Plant Engineers and Managers Guide to Energy Conservation, CRC Press.
4. I. G. C. Dryden , The Efficient Use of Energy, IPC Science and Technology Press.
5. S. C. Tripathy, Electric Energy Utilisation and Conservation, Tata McGraw-Hill Publishing Company Ltd.
6. P. H. Henderson: India- The Energy sector, Oxford University Press.
7. W. C. Turner, editor: The efficient use of energy (Butterworths)
8. Frank Keith, Yogi Goswami, "Enegy Management and End use Efficiency Handbook" Taylor and Francis.
9. Donald A. Wulfinghoff, Energy Efficiency Manual, Energy Institute Press.

411085

ELECTIVE-II (A): ADVANCED WELDING

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit 1: Introduction **[7]**
Importance and application of welding, classification of welding processes. Selection of welding process, brief review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electro slag welding, Friction welding etc. Welding of MS, CI, Al, Stainless steel & Maurer/Schaefflar Diagram. Soldering and Brazing.

Unit 2: Advanced Welding Techniques **[7]**
Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.

Unit 3: Weld Design **[7]**
Welding machines/equipment and its characteristics and arc-stability, Weld defects and distortion and its remedies, Inspection/testing of welds, Weld Design, Welding of pipe-lines and pressure vessels. Life predication.

Unit 4: Metal Transfer And Melting Rate **[7]**
Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

Unit 5: Thermal And Metallurgical Consideration **[7]**
Thermal considerations for welding, temperature distribution, Analytical/Empirical analysis/formulae, heating & cooling curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties.

Unit 6: Welding Of Plastics And Composites **[7]**
Principle of welding plastics, common weldable plastics, welding joint design, surface preparation, plastic welding processes, principle of operation, equipment required, Advantages, Applications.

References:

1. R. S. Parmar, “Welding processes and technology”, Khanna Publishers, ISBN: 8174091262.
2. Raj, Shankar, Bhandari, “Welding Technology for Engineers”, Narosa Publication House Pvt. Limited.

3. S.V. Nandkarni, “Modern Arc Welding Technology”, Oxford and IDH publishing Co. Pvt. Ltd, New Delhi – 2010, ISBN: 9788120416765.
4. L.M. Gourd, “Principles of Welding Technology”, ELBS: E. Arnold, London, 2nd Edition, 986, ISBN : 978-1-60525-797-6.
5. J. F. Lancaster, “The Physics of welding”, PergamonPress, Oxford, 1986. ISBN/ISSN:008034075X 9780080340753.
6. “Welding Handbook”, Vol. 1, 7th edition; American welding society. ISBN-13:9780871711267.
7. Richard L. Little, “Welding and Welding Technology”, McGraw-Hill New York, [1973], ISBN: 0070380953, 9780070380950.

411085

ELECTIVE-II (B): MATERIALS TECHNOLOGY

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Elastic and Plastic Behavior [7]

Elasticity in metals and polymers, Mechanism of plastic deformation, role of dislocations, Yield stress, shear strength of perfect and real crystals, Strengthening mechanisms, work hardening, solid solution and grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviours, Super plasticity, Deformation of non crystalline material.

Unit II: Fracture Behavior [7]

Griffith's theory, stress intensity factor and fracture toughness, Toughening mechanisms, Ductile-brittle transition in steel, High temperature fracture, creep: Larson-Miller parameter, Deformation and fracture mechanism maps, Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law, Effect of surface and metallurgical parameters on fatigue, Fracture of non metallic materials, Failure analysis, sources of failure, procedure of failure analysis.

Unit III: Selection of Materials [7]

Motivation for selection, cost basis and service requirements, Selection for mechanical properties, strength, toughness, fatigue and creep. Selection for surface durability corrosion and wear resistance, Relationship between materials selection and processing, Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

Unit IV: Modern Metallic Materials [7]

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel - Intermetallics, Ni and Ti aluminides, Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials, biomaterials.

Unit V: Non-Metallic Materials [7]

Plastics, rubber, foams, adhesives and coatings - Structure, properties and applications of engineering polymers - Advanced structural ceramics, WC, TiC, TaC, AI2O3, SiC, Si3N4, CBN and diamond - properties, processing and applications.

Unit VI: Composite Materials

Reinforced fibers, Particle strengthened and laminar composites-- production techniques of each type, Production of fibers, properties mechanics of composites, manufacturing of metal matrix, Ceramic matrix composite, Carbon-Carbon composite- properties and testing of composite material, areas of application.

References:

1. Flinn, R. A. and Trojan P.K., "Engineering Materials and their Applications ", (4th Edition, (1990), Jaico Publishing House Publisher, ISBN: 8172246773.
2. George E. Dieter, "Mechanical Metallurgy ", McGraw Hill, 1988, ISBN 0-07-100406-8.
3. ASM Hand Book, Vol.11, "Failure Analysis and Prevention ".
4. Willam F. Smith, "Principles of Materials Science and Engineering", 3rd edition, McGraw Hill, ISBN: 0070592411.
5. Mathew Philip, William Bolton "Technology of engineering materials" Butterworth-Heinemann, (2002), ISBN: 9780750656436.
6. Martin J. W. "Materials for Engineering" Institute of Materials, Minerals and Mining (2002), ISBN: 9781902653501

411085

ELECTIVE-II (C): SURFACE ENGINEERING

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Introduction of Surface Dependent Properties [7]

Introduction to various corrosion prevention methods, Classification and scope of surface modification techniques in metals, ceramics, polymers and composites, Tailoring of surfaces of advanced materials, Surface dependent engineering properties, viz. wear, friction, corrosion, fatigue, reflectivity, emissivity, etc., common surface initiated engineering failures, mechanism of surface degradation; importance and necessity of surface engineering.

Unit II: Various Surface Cleaning Processes [7]

Classification and Selection of Cleaning processes, Acid and Alkaline Salt bath, Ultrasonic,

Mechanical cleaning, Pickling and de-scaling, study of process details, applications and Environmental concern of each cleaning method, Electrochemistry and electro-deposition, electro less deposition Process details. Scope and application of conventionally deposited materials like Copper Nickel.

Unit III: Coatings [7]

Various coating types like Cathodic and Anodic coatings, Hot dipping (Tinning, Galvanising, Aluminising), Metal cladding, Diffusion coatings like carburising, nitriding, cyaniding, Sherardising, Calorising and Chromosing. Chemical conversion coatings like Phosphate, Chromate, Oxide, and Anodized. Various Organic coatings like Paints, varnishes, Enamel and Lacquers Thermal spray coatings, like Flame spray, Electric arc spray, Plasma spray, High velocity Oxy Fuel (HVOF) coating.

Unit IV: Other Surface Engineering Processes [7]

Influence of manufacturing processes on various surface properties of an engineering component, scope of surface engineering in augmentation of surface properties, Physical vapour deposition (PVD), Chemical vapour deposition (CVD) Process, Plasma enhanced Surface engineering, Ion Implantation, thin films coatings for engineering surfaces.

Unit V: Testing and Characterization Of Coatings [7]

Control properties, response properties, surface geometry characterization Techniques (conventional and recent trends), coating thickness measurements, laboratory techniques and

special techniques for accurate routine thickness measurements, adhesion measurement, conventional methods and recent developments, Quality assurance of coating process.

Unit VI: Recent Trends in Surface Engineering [7]

Measurement of mechanical properties of engineered surface in nano scale, Evaluation of tribological characteristics of engineered surface in macro, micro and nano scale, simulation of actual application environment in tribometer, High temperature coatings, Wear resistant coatings Use of Laser in Surface Engineering, Environmental protection issues.

References

1. Bharat Bhushan, "Introduction to Tribology" John Wiley and Sons, ISBN: 0471158933
2. N.J. Persson, "Sliding Friction" Springer, ISBN: 3540671927
3. Gwidon Stachowiak, A W Batchelor, "Engineering Tribology", Butterworth-Heinemann, ISBN: 0750678364
4. ASM Hand Book, Vol. 5, "Surface Engineering".

411085

ELECTIVE-II (D): INTELLIGENT MANUFACTURING SYSTEMS

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	In semester: 30 Marks
	End semester: 70 Marks

Unit I: Introduction to artificial intelligent techniques [7]

Goals of AI in manufacturing, tools for AI such as Search algorithm, Mathematical optimization, Evolutionary computation, fuzzy logic, Probabilistic methods for uncertain reasoning such as Bayesian network, Hidden Markov model, Kalman filter, Decision theory and Utility theory, statistical learning methods, support vector machines, neural networks, expert systems.

Unit II: Industrial planning and decision making using intelligent systems [7]

Production planning using fuzzy cognitive maps, computer aided process planning, Methods for inventory space allocation and storage processes analysis, Optimization of production costs and methods finding of the best process plan, Methods for production equipment selection and layout, Heuristic scheduling of multiple resources, Fuzzy multiple attribute decision making methods.

Unit III: Intelligent techniques for manufacturing process optimization [7]

Application of neural networks and fuzzy sets to machining and metal forming, Artificial neural network modeling of surface quality characteristics in machining processes, parametric optimization of machining processes using evolutionary optimization methods**.**

Unit IV: Knowledge Based Group Technology [7]

Group Technology: Models and Algorithms – Visual method, Coding method, Cluster analysis method
Knowledge based group technology – Group technology in automated manufacturing system, Structure of knowledge based system for group technology (KBSGT) –database, knowledge base, Clustering algorithms

Unit V: Intelligent robotic systems [7]

Applications of intelligent systems for mobile Robot Motion Planning, Path Planning Robot Control in Dynamic Environments, Task Based Hybrid Closure Grasping Optimization for Autonomous Robot Hand. Accurate Motion Control of Fast Mobile Robots, obstacle avoidance.

Unit VI: Use of intelligent techniques in flexible manufacturing systems (FMS) [7]

Applications of various intelligent systems for FMS functional segmentation schemes including control, real time scheduling, tool management, process planning, route optimization for AS/RS systems.

References:

1. Andrew Kussiak, "Intelligent Manufacturing Systems", Prentice Hall , 1990
2. Badiru A.B., "Expert Systems Applications in Engineering and Manufacturing", Prentice-Hall, New Jersey, 1992.
3. Liu, Dikai, Wang, Lingfeng, Tan, Kay Chen (Eds.) Design and Control of Intelligent Robotic Systems, Springer-Verlag, London. ISBN 978-3-540-89932-7
4. Rao R. V. "Advanced Modeling and Optimization of Manufacturing Processes", Springer-verlag, London. ISBN 978-0-85729-014-4

411086

MACHINE TOOL DESIGN

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Oral: 50 Marks

Practical/Design Assignments:

1. Design and working drawing of speed gear box
2. Design and working drawing of feed gear box
3. Study of stepless drives
5. Design for spindle or power screw.
6. Design for guide ways and slide ways.
7. Internet assignment based on any one of the topics above.

411087

AUTOMATION AND CONTROL ENGINEERING

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Practical: 50 Marks

Practical Work:

1. Study of basics of automation.
2. Study of hydraulic circuits - hydraulic press, machine tools, automobile systems, etc
3. Study of pneumatic circuits.
4. Use of microprocessors: Applications in manufacturing engineering.
5 Study and experiments in programmable logic controllers: Ladder logic programming
6. Study of data conversion.(ADC/DAC)
7. Study of automation in material handling system.
8*. Industrial visit report on automation in any Industry.

* Industrial visit is compulsory.

411088

OPERATIONS RESEARCH

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term Work:

One exercise on each unit. At least one Computer Software Package such as Lindo/Lingo, MATLAB, MS-Excel/MS-Projects, Tora etc. should be used.

411089

ELECTIVE II (A): ADVANCED WELDING

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on one assignment on each Unit.

411089

ELECTIVE II (B): MATERIALS TECHNOLOGY

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on one assignment on each Unit.

411089

ELECTIVE II (C): SURFACE ENGINEERING

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on one assignment on each Unit.

411089

ELECTIVE II (D): INTELLIGENT MANUFACTURING SYSTEM

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on following assignments:

2. Study of Artificial Intelligent techniques with application examples
3. Case studies on industrial decision making using fuzzy multiple attribute decision making
4. Applications of artificial neural networks to manufacturing engineering
5. Study of various clustering algorithms for group technology
6. Study of algorithms for robot path planning/obstacle avoidance
7. Case study on route optimization of AS/RS systems.

411090

PROJECT PHASE-I

Teaching Scheme	**Examination Scheme**
Tutorial: 2 hrs/week	Term work: 50 Marks

The student shall take up a suitable project, the scope of the project shall be such as to complete it within the time schedule, the term work shall consist of:

1. Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hi-tech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Above work shall be taken up individually or in groups. *The group shall not be more than 4 students,*

OR

Extensive analysis of some problems done with the help of a computer individually or in a group not exceeding two students.

2. A detailed report on the work done shall include project specification, design procedure, drawings, process sheets, assembly procedure and test results etc. Project may be of the following types:

i. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
ii. Improvement of existing machine / equipment / process.
iii. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
iv. Computer aided design, analysis *of* components such as stress analysis.
v. Problems related to Productivity improvements/Value Engineering/Material Handling Systems
vi. Energy Audit of an organization, Industrial evaluation of machine devices.
vii. Design of a test rig for performance evaluation of machine devices.
viii. Product design and development.
ix. Analysis, evaluation and experimental verification of any engineering problem
x. Quality systems and management. Total Quality Management.
xi. Quality improvements, In-process Inspection, Online gauging.
xii. Low cost automation, Computer Aided Automation in Manufacturing.
xiii. Time and Motion study, Job evaluation and Merit rating
xiv. Ergonomics and safety aspects under industrial environment
xv. Management Information System.
xvi. Market Analysis in conjunction with Production Planning and Control.

OR

Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. When a group of students is doing a project, names of all the students shall be included on every certified report copy.

Two copies of Seminar Report shall be submitted to the college. The students shall present their Project Phase-I report.

411091

COMPUTER INTEGRATED DESIGN & MANUFCTURING

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Computer Aided Design (CAD) [6]

CAD cycle for product design, CAD workstations - data communications - input/output devices, display technology, CAD software. Transformation- Introduction, Formulation, Translation, Rotation, Scaling, Reflection, Homogenous Representation, Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations.
Geometric modeling: Wireframe modeling, Surface modeling: Representation of curves and surfaces, design of curves: cubic splines, bezier curves and B-spline, design of surfaces. Solid modeling techniques.

Unit II: Computer Applications in Engineering Analysis [6]

One dimensional problems: Finite elements modeling, Co-ordinates and shape functions,

Potential Energy Approach, Galerkin Approach, Assembly of Global Stiffness Matrix and Load Vector, Finite Element equations. Truss problems: Plane trusses, Three-dimensional trusses, Two dimensional problems: Finite element modeling, constant strain triangle, Problem modeling and Boundary conditions, Axi-symmetric Solids subjected to axi-symmetric loading,

Unit III: Computer Aided Manufacturing (CAM) [6]

Concepts and features of NC, CNC & DNC - feed back devices ,Interpolators., Point-to-point and contouring systems – Interchangeable tooling system – preset & qualified tools – ISO specification – Machining center – Turning center ,
CNC Programming:- Machine Tool Co-ordinate System, Machine zero, Job zero, Cutter Programming, Tool Offsets, Manual part programming – steps involved – G-codes and M-codes, sample program in lathe & milling. CAM package – canned cycles - Programming.

Unit IV: Computer Integrated Manufacturing (CIM) [6]

Computer application in manufacturing automation and Robotics, Robot programming,
computer aided inspection and quality control. Computer integrated production management system, inventory, material requirement planning, manufacturing resource planning, enterprise resource planning

Unit V: Group Technology Cellular Manufacturing and Flexible Manufacturing System [6]

Part families – visual – parts classification and coding – case studies in coding – Production flow analysis – benefits of G.T. – Application of G.T. Cellular Manufacturing –Machine cell design – Key machine concept - quantitative analysis in cellular manufacturing – Rank order clustering technique – Arranging machines in G.T. Cell –

FMS – Types of FMS – FMS components – Workstations, Material Handling and storage system – FMS Layout type, computer control system, Human resource – FMS application and benefits – FMS planning and implementation issues. Quantitative analysis of FMS – CANQ, deterministic models.

Unit VI: CIM Models and Rapid Prototyping [6]

Introduction, ESPRIT – CIM OSA Model, The NIST – AMRF Hierarchical Model, The Siemens Model of CIM, The CIM model of Digital Equipment Corporation, IBM concept of CIM, Present Scenario, Rapid Product Development and Manufacture, Extended Enterprises. Methods of rapid prototyping: steriolithography, Laminated Object Manufacturing (LOM), Fused Deposition Modeling (FDM), selective laser sintering, solid ground curing, 3D Printing system, Application of rapid tooling methods to press tool manufacture

Term Work:

The term work shall consist of assignments based on the following topics. Evaluation of practical will be based on Oral examination.

1. Construction of parametric solid model of any machine elements using software package.
2. Programming on CNC Lathe/Milling.
3. Programming on Robot application.
4. Flexible Manufacturing Systems.
5. Manufacturing Resource Planning.
6. Simulation of a simple mechanical system

Text Books:

1. Radhakrishnan.P, Subramanyan.S and Raju.V, "CAD/CAM/CIM", New Age International Publishers, 2000
2. Groover and Zimmers, "CAD / CAM: Computer Aided Design and Manufacturing", Prentice Hall of India, New Delhi (1994).
3. Zeid Ibrahim, "CAD - CAM Theory and Practice", Tata McGraw Hill Publishing Co. Ltd.(2000).
4. Kundra T.K., Rao P.N., Tiwari N.K., "Numerical control and Computer aided manufacturing",Tata McGraw Hill 1992.

Reference Books:

1. James A.Retrg and Henry W. Kraebher, "Computer Integrated Manufacturing", Pearson Education, Asia, 2001
2. Viswamathan.N and Narahari.Y, "Performance Modelling of Automated Manufacturing System", Prentice Hall of India Private Limited, 1994.
3. Chandrupatla T.R., Belegundu A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India 2003.

411092

PRODUCT DESIGN & DEVELOPMENT

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In-semester: 30 Marks
End semester: 70 Marks

Unit I
Introduction to Product Design
Introduction to engineering design process, Industrial design, Importance of the engineering Design process, Types of designs, Engineering design process, A simplified iteration model, Design method versus scientific method,A problem-solving methodology, Considerations of a good design, Total life cycle, Regulatory and social issues, Description of design process, Conceptual design ,Concept generation and selection, Concept testing, Prototyping, and product cost analysis, Embodiment design, Detail design, Planning for manufacture, Planning for distribution, Planning for use, Planning for retirement of the product, Product cannibalization and petrification.

Unit II
Approaches and techniques for Product Design
Mass customization, Kano model, Kansei engineering, Conjoint analysis, Product architecture, Modular product architecture, Product line design, Product configuration and concurrent engineering, Product data management.

Unit III
Product Development Process:
Product life cycle, Generic product design process, Stage gate system of product development, Types of products, Product planning, Markets and marketing, Markets, Market segmentation, Functions of a marketing department, Elements of a marketing plan, Technological innovation, Invention and Diffusion, Business strategies related to innovation and product development.

Unit IV
Understanding customer requirements
Identifying customer needs, Voice of customers, Methods of Voice of customers (VoCs) preliminary research on customers' needs, Gathering information from customers, Customer requirements, Differing views of customer requirements, Classifying customer requirements, Establishing the engineering characteristics, Benchmarking in general, Competitive performance benchmarking, Reverse engineering or product dissection, Determining engineering characteristics, Types of design information, Sources of design information, Quality function deployment, The house of quality, Steps for building a house of quality.

Unit V
Design for X
Role of manufacturing in design, Types of manufacturing processes, Types of manufacturing systems, Manufacturing process selection quantity of parts required,Shape and feature

complexity, Influence of material on process selection, Required quality of the part ,Cost to manufacture, Availability, Lead time, and delivery, Further information for process selection.

Design for Manufacture (DFM): DFM guidelines, Specific design rules,Design of castings**,** Guidelines for the design of castings ,Producing quality Castings ,Design of forgings DFM guidelines for closed-die forging, Design for sheet-metal forming sheet metal stamping, Sheet bending, Deep drawing, Injection molding.

Unit VI

Innovative Case Studies in Product Development

Case studies confined to auto industry, Home appliances, etc., Software based applications and case studies in PLM.

Text Books

1. A.C. Chitale and R.C. Gupta, Product Design and Manufacturing by PHI.
2. Karl T. Ulrich & Steven D. Eppinger., Product Design & Development, McGrawHill, 3rd Edition, 2003.
3. Dieter and Schmidt , Engineering Design, McGraw – Hill Higher education, ISBN: 978–0–07–283703–2

Reference Books

1. Tim Jones, Butterworth Heinmann, New Product Development by Oxford, TAC- 1997.
2. Roland Engene Y.,Inetoviez, New Product Development: Design & Analysis, John Wiley and Sons Inc., N.Y. 1990.
3. GeoffreyBoothroyd, Peter Dewhurst and Winston Knight. Product Design for Manufacture and Assembly, Amherst, 1983.
4. Bill Hollins, Stwout Pugh, Butterworth, Successful Product Design by London 1990.
5. Boothroyd&DewburstP.,Design for Assembly, a Designer's Hand book, University of Massachusets, Amherst, 1983.
6. Keyinotto and Kristini Wood, Product Design Pearson Education 2004.
7. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub. 1986
8. ISO Standard: 9001:2008: Clauses 7.1, 7.2, 7.3

411093

ELECTIVE-III (A): MATERIALS AND LOGISTIC MANAGEMENT

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Materials Management [8]

Introduction to Material Management functions, scope, objectives, tools and techniques. Make or buy decision, Material Requirement Planning (MRP1).

Value analysis: Value analysis / Value analysis engineering, concepts, advantages, applications, problem recognition, role of creativity, analysis of functions, use, esteem and exchange values elimination of unnecessary costs, value engineering techniques.

Unit II: Purchase Management [8]

Objectives, functions, purchase cycle, documents in purchasing, purchasing with 5 R'S (Quality, Quantity, Time, Supplier, Price), vendor rating and vendor development.
Import and Import Substitution: Factors affecting National and International markets, Import procedure and documents (Bill of lading, letter of credit etc.)

Unit III: Stores Management [8]

Functions of stores, types of stores, stores identification, receipt-issue, recording system, stock taking system.

Waste Management: Importance of waste management and techniques. waste management system, Disposal of surplus and obsolete items. Mechanical and thermal disposal system.

Unit IV: Logistic Management [8]

Operating Responsibility, Logistical performance Cycle, Work of Logistics, Functional areas of logistics

Warehouse Management: Nature and importance of warehousing, warehouse location, warehousing operations and Facility development. Economic and service benefits of warehouse.

Transportation Management: Transport planning parameters, Basic Economics & pricing factors affecting transportation cost.

Unit V: Supply Chain Management [8]

Introduction, Types of supply chain, Components, Drivers, Role of supply chain in manufacturing, Supply chain performance and its measurement, Planning, Demand and supply in supply chain, Risk in supply chain and managing the risk, Coordination in supply chain.

Unit VI: Inventory control of finished goods [8]

Economic manufacturing quantity (EMQ), Fixed order quantity and fixed order interval system, Probabilistic models, Safety stocks, service levels, inventory control of finished goods, single order inventory policies. Inventory models under risk and under uncertainty.

Text Books:

1. Dobler and Lee, "*Purchasing and Material Management*", Tata McGraw Hill, New Delhi
2. Jhamb, L.C., "*Inventory Management*", Everest Publications,
3. Menon, K.S., "*Purchasing and Inventory Control*", Wheeler Publication, New Delhi
4. Chopra Sunil and Peter Meindl., "Supply Chain Management: Strategy, Planning and Operation",3rd Edition, Prentice Hall, 2006.

Reference Books:

1. Miles L.D., "Techniques of Value Analysis and Engineering", McGraw Hill Book Company.
2. Simchi-Levi, Kaminsky, "Designing and Managing the Supply Chain, Concepts Strategies and Case studies", 2nd Edition, Tata McGraw Hill, New Delhi
3. James R. Stock and Diouglas M. Lambert, "Strategic Logistics Management" 4th Edition, McGraw Hill International Edition.
4. Bowersox D.J., Closs, D.J., "Logistical Management", McGraw Hill Book Company, Singapore

411093

ELECTIVE-III (B): FINITE ELEMENT ANALYSIS

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Introduction **[8]**

Introduction, One Dimensional Problem, Finite Element modeling, Coordinate and Shape function, Derivation of stiffness matrix and Load Vector using Potential Energy approach, Properties of Stiffness Matrix, Assembly of Global Stiffness Matrix and Load Vector, Elimination and penalty approach, shape function, Quadratic Shape Function.

Unit II: Trusses **[8]**

Introduction, Plane trusses, Assembly of global Stiffness Matrix for Banded Skyline solutions.

Unit III: Two-Dimensional Problem Using Constant Strain Triangles **[8]**

Introduction, finite element formulation, load considerations and boundary conditions, problem modeling, member end forces, plane frame.

Unit IV: Axi-symmetric solids subjected to axi-symmetric loading **[8]**

Introduction, axi-symmetric formulation, finite element modeling of triangular element

Two dimensional iso-parametric elements **[8]**

Introduction, four node quadrilateral, introduction to higher order elements.

Unit V: Finite element analysis of heat transfer **[8]**

Introduction, steady state heat transfer - 1D and 2D heat conduction and convection, governing differential equation, boundary conditions, formulation of element.

Unit VI: Software based FEA **[8]**

Mesh generation, meshing techniques, meshing in critical areas, type and size of element, mapped elements, quality checks-[aspect ratio, warp angle, skew, Jacobean, distortion, stretch, included angle, taper], boundary conditions, interpretation of results and design modification

411093

ELECTIVE-III (C): WORLD CLASS MANUFCTURING

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Historical Perspective **[8]**

World class Excellent organizations – Models for manufacturing excellence: Schonberger, Halls, Gunn and Maskell models, Business Excellence.

Unit II: Benchmark, Bottlenecks and Best Practices **[8]**

Concepts of benchmarking, Bottleneck and best practices, Best performers – Gaining competitive edge through world class manufacturing – Value added manufacturing – Value Stream mapping - Eliminating waste –Toyota Production System –Example.

UNIT-III: System and Tools for World Class Manufacturing **[8]**

Improving Product & Process Design – Lean Production – SQC, FMS, Rapid Prototyping , Poka Yoke, 5-S ,3 M, JIT, Product Mix , Optimizing , Procurement & stores practices , Total Productive maintenance, Visual Control.

Unit IV: Human Resource Management in WCM **[8]**

Adding value to the organization– Organizational learning – techniques of removing Root cause of problems–People as problem solvers–New organizational structures. Associates–Facilitators–Teamsmanship–Motivation and reward in the age of continuous improvement.

Unit V: Typical Characteristics of WCM Companies **[8]**

Performance indicators like POP, TOPP and AMBITE systems– what is world class Performance –Six Sigma philosophy

Unit VI: Indian Scenario **[8]**

Case studies on leading Indian companies towards world class manufacturing –Task Ahead.
Green Manufacturing, Clean manufacturing, Agile manufacturing

Text Books

1. Sahay B.S., Saxena KBC. and Ashish Kumar, ”World Class Manufacturing – Strategic Perspective, Mac Milan Publications, New Delhi.
2. Korgaonkar M.G., “Just In Time Manufacturing”, MacMilan Publications
3. Narayanan V.K., “Managing Technology and Innovation for Competitive Advantage”,Prentice Hall, 2000

References:

1. Adam and Ebert, “Production and Operational Management”, 5th Edition, Prentice Hall learning pvt. Ltd., New Delhi.
2. Ron Moore, “Making Common Sense Common Practice – Models for manufacturingexcellence”, Butter worth Heinmann
3. Jeffrey K.Liker, “The Toyota Way – 14 Management Principles”, Mc-Graw Hill, 2003.
4. Chase Richard B., Jacob Robert., Operations Management for Competitive Advantage”,11th Edition, McGraw Hill Publications, 2005.
5. Moore Ron, “Making Common Sense Common Practice”, Butterworth-Heinemann, 2002.
6. Womack J.P., Jones D.T., “Machine That Changed The World: The Story of LeanProduction”, Harper Perennial, 1991.

411093

ELECTIVE-III (D): INDUSTRIAL RELATIONS AND HUMAN RESOURCES

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Introduction to Management

Characteristics, objectives Functions, Principles and Types of Management., Scientific Management-Contribution of F. W. Taylor, Henry Fayol and Indian contributors

Organization :Definition, Principles, Function and Types of organization structure, Different forms of Business—Proprietor, Partnership Firm, Private & Public limited company, Cooperative, Private & Public Trusts.

Unit II: Motivation: Human

Needs and Types of Motivation, Theories of Motivations-Maslow's theory, McGregor's Theory of X and Theory of Y, Herzberg's Theory of two factor, David C. McCelland's Theory of Achievement, Expectance/valence Theory of Victor Vroom, Porter & Lawler's Model.
Group dynamics: Characteristics of group, The meaning of group & group behavior & group dynamics, Types of groups
Leadership: Definition, styles & functions of leadership, qualities for good leadership, role of the leader, Theories of leadership, Managerial grid.

Unit III: Human Resource Management:

Definition, Objective of Human Resource Management Characteristics, Functions/Scope, Principles of Human Resource Management, Professionalization of human resource management in India, Human resource management in changing scenario of business, New directions in human resource management, Manpower Planning –factors Affecting Manpower Planning, Steps in Manpower Planning, recruitment and selection procedure of Manpower, Retirement/Separation-Superannuation-Voluntary Retirement Schemes, Resignation-Discharge-Dismissal-Suspension-Layoff, Career Planning and Development

Unit IV: Training and Development of Manpower:

Need of Training, Benefits of Training, Method of Training Workers, training curriculum planning; choice of training methodologies; training facilities and equipments; in-service training; outside training; re-training; advanced training; designing training programmes; employee counseling; executive development programmes; evaluation of training and development programmes Foreman or Supervisory Training, Executive/Managers Training and Development, Learning curves and classifications, Management By Objectives [MBO]

Unit V: Industrial Relations:

Definition of Industrial Relations, History, Governmental Measures – Ministry for labor, Commissioner of labor, Deputy Commissioner & Labor Offices. The various approaches to Industrial Relations, Impact of Liberalization, Privatization and Globalization on Indian

Industrial Relations, successful industrial relations programme, industrial discipline, grievances, Industrial Health and Industrial Safety, Trade Unions, Principles of public relations, Collective Bargaining, Worker participation in Management, concept of Quality of Work Life (QWL)

Wages and Incentives: Concept of wages, factors affecting wages, Types of wage plans, Job Analysis, Job Evaluation and Merit Rating, Payment of wages act-1936 The Employees' Provident Fund & Miscellaneous Provisions Act, 1952

Unit VI: Industrial Acts/Laws:

The Indian Factories Act, 1948, The Industrial Dispute Act-1947, The Trade Union Act 1926, Industrial Employment (Standing Orders) Act, 1946, The Payment of Bonus Act, 1965, Employees Provident Funds (and Misc. Provisions) Act, 1952, Workmen's Compensation Act, 1923 (WC Act), Employees' State Insurance Act, 1948 (ESI Act), Payment of Gratuity Act, 1972 (PG Act), Child Labor (Prohibition & Regulation) Act, 1986, The Monopolies and Restrictive Trade Practices Act, 1969, The Competition Act 2002, The Sale of Goods Act- 1930

Text Books

1. Khanna O. P., "Industrial Engineering and Management", Dhanpat Rai and sons, 2007.
2. Gary Dessler & Biju Varkkey, "Human Resource Management", Pearson Education.
3. Mizra S. Saiyadain, "Human Resources Management", 4th Ed, Tata McGraw Hill. New Delhi
4. K . Aswathappa, "Human Resource Management- Text & Cases", Tata McGraw Hill, New Delhi
5. ArunMonappa, Mizra S. Saiyadain, "Personnel Management", Tata McGraw Hill, New Delhi
6. C.B. Mamoria, S.V.Gankar " Personnel Management", Himalaya Publishing House

Reference Books

1. Koontz Harold and Weihrich Heinz, "Essentials of Management", Tata McGraw Hill publishing, 2008, ISBN 0-07-0623030-x.
2. Luthans f**.,** "Organizational Behaviour", McGraw-Hill Company, 2008, ISBN 81-317-05021.
3. K. Ashwathappa " Organizational Behaviour", Himalaya Publishing House
4. K. Ashwathappa,"Human Resource and Personnel Management",Tata McGraw Hill Publishing Co. Ltd., New Delhi
5. Pramod Verma, "Management of Industrial Relations", Oxford and IBH Publishing Co., Mumbai.
6. C. Jagamohandas and Co., Mumbai – Publications of Acts with short notes.

411094

ELECTIVE-IV (A): INDUSTRIAL ROBOTICS

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit 1: Basic Concepts in Robotics [8]

Automation and robotics, robot anatomy, Development of industrial Robots and manipulators, basic structure of robots, resolution, accuracy and repeatability. Classification, Configuration of robots, arm and body motions, wrist motions. Robot Drives, Basic Control systems, P, PI & PID control systems.

Unit II: Robot Arm Kinematics and Dynamics [8]

The direct kinematics problem, the inverse kinematic solution, Homogeneous transformation.

Dennavit -Hartenberg's convention for dynamic analysis of Joints, Global & Local Coordinates for analysis. Burmester theories and analytical techniques, Applications, Lagrange-Euler formation, generalized D'Alembert equations of motion, Spatial mechanisms.

Unit III: Robot Grippers [8]

Classification, Design consideration, Materials for hostile operation. Cylindrical Cam type; Grippers using pneumatic, hydraulic and electrical motor for transmission; Vacuum Grippers, ultrasonic grippers.

Unit IV: Sensors and Machine vision systems in Robotics [8]

Sensors -functioning, types, analysis and fields of applications. Tactile sensors, temperature sensors, Variable Pressure Light Converting Sensor, High Resolution Pneumatic tactile Sensor, Slip type Sensors, Piezoelectric Contact Sensors. Remote Sensor Compliance, Range &Proximity Sensors, Electro-optical Sensors.

Vision system: Median filtering, thresholding, discretisation, Smoothening of binary image. Edge detection algorithm, region growing algorithm.

Unit V: Robot Programming and Artificial Intelligence [8]

Robot Programming: Methods of Programming the robot, Methods of defining positions in space, Motion interpolation, branching, Textual robot programming languages.

Artificial Intelligence: Concept of A.I., Approaches, foundations of A.I. Problem formulation: Problem solving agents, components of problem definition, defining the problem as state space approach.

Unit VI: Advanced Applications of Robots and Robot Interfacing [8]

Pick and place Robot, Arc Welding Robots, Assembly and mega-assembly Robots, Walking Robots, Climbing Robots, Machine mounted Robots. Interfacing Robots with computers.

Obstacle Avoidance: Lee's Algorithm; Counter Path Defining using 'via' point, blending technique.

Text Books:

1. Deb S.R., “Robotics”, Tata McGraw Hill Publications, New Delhi.
2. Yoram Koren, "Robotics for Engineers", McGraw Hill Book Co.
3. Groover M.P., Weiss M., Nagel R.N., Odrey N.G., "Industrial Robotics Technology-Programming and Applications", McGraw Hill Book Co.
4. Fu K.S., Gonzalex R.C., Lee C.S.G., "Robotics Control Sensing, Vision and intelligence",McGraw Hill Book Co.

Reference Books

1. Hartenberg and Denavit, "Kinematics and Synthesis of Linkages", McGraw Hill Book Co.
2. Hall A.S., "Kinematics and Linkage Design", Prentice Hall.
3. Hirchhorn J., "Kinematics and Dynamics of Machinery", McGraw Hill Book Co.
4. Todd D.J., “Fundamentals of Robot Technology”, Wiley Publications
5. Paul R., “Robots -Manipulators, Mathematics, Programming and Control”, MIT Press.
6. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill 1995

411094

ELECTIVE-IV (B): SIMULATION & MODELING

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Principles of Simulation and Modeling [8]

A review of basic probability and statistics, Definition and concepts of simulation and modeling, steps in a simulation study, Modeling concepts, Advantages, Disadvantages and Applications areas of simulation Basic principles of simulation modeling, Model based problem solving

Unit II: System Simulation [8]

Types of simulation: Physical vs. Mathematical, Static vs. Dynamic, Deterministic vs. Stochastic, Continuous vs. Discrete simulation models, Continuous, Discrete event, Monte-Carlo simulation methods and their applications in inventory and queuing problems (single server queuing system) – problem organization and logic.

Unit III: Input Data Analysis [8]

Nature of simulation, Roots of simulation input modeling, Data collection, Identifying distribution, Histograms, practical methods for testing assumptions

Random Number Generation: Introduction, Desired properties, Generation of pseudo random numbers

Unit IV: Random Variate Generation [8]

Introduction, Factors considered in selecting generator, Generating continuous random variates like Uniform, Exponential, Weibull, Normal

Output Data Analysis

Introduction, Types of simulations with regard to output analysis – terminating and non terminating simulation

Unit V: Simulation of Manufacturing Systems [8]

Need of simulation in manufacturing and material handling systems, Components of manufacturing systems – product, resources, demand, control; Downtime, Rework and reentrancy, Random events and performance measures used in manufacturing systems with a case study on any manufacturing system

Material Handling Systems – Input parameters for automated material handling systems,

Conveyor and vehicle systems, job shop with material handling and flexible manufacturing systems.

Unit VI: Simulation Software **[8]**

Simulation software: Introduction, Comparison of simulation software with programming languages – SLAM, SIMAN. Desirable software features, Classification of simulation software,

General purpose and object oriented simulation software packages –

ARENA/SimFactory/Promodel/ Witness

Text Books:

1. Averill M Law, "Simulation Modeling and Analysis", Fourth Edition, Tata McGraw Hill
2. Education Private Ltd, New Delhi, 2010.
3. Banks, J., J. S. Carson II, and B. L. Nelson. "Discrete-Event System Simulation", Second Edition, Prentice Hall, Upper Saddle River, New Jersey, 1996. Bratley, P., B. L. Fox, and L. E. Schrage "A Guide to Simulation", 2nd ed., Springer-Verlag, New York, 1987.
4. Fishman, G.S., "Monte Carlo: Concepts, Algorithms and Applications", Chapman & Hall, New York, 1996.

References:

1. Jerry Banks (Ed.), "Handbook of Simulation – Principles, Methodology, Advances,Applications and Practice", Wiley – Interscience Publication, 1998
2. Gordon G., "System Simulation", 2nd Edition, Prentice Hall,1978
3. Nelson, B. L., "Stochastic Modeling: Analysis and Simulation", McGraw-Hill, New York, 1995.

411094

ELECTIVE-IV (C): AUTOMOBILE ENGINEERING

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit-I: Introduction to Automobile Engineering & safety [7]

Automobile - history and development, classification, vehicle layout-engine location and drive arrangement, types of vehicle bodies, chassis types, constructional details, frames, sub frames, frameless vehicles, vehicle dimensions.

Vehicle safety- active, passive safety, air bags, seat belt, types of collisions-front, rear, side, vehicle interior and ergonomics safety regulations of vehicles.

Classification and construction of I.C. engine

Unit II: Fuel supply system and cooling systems. [7]

Fuel supply system- S.I. Engine, carburation, Air-fuel requirements, simple carburetor & classification, Modern Carburetors (Solex & S.I carburetor). Fuel injection in S.I. engine M.P.F.I & G.D.I

C.I. engine – classification of fuel supply system- solid injection system fuel injection pump

Bosch Pump and injector

Cooling system – necessity of cooling, under cooling, overcooling, types of cooling system components, working of pressurized force & thermostatic , coolant additives

Unit III: lubrication and Ignition system [7]

Lubrication system- objective of lubrication, types of lubricants, properties and additives, types of lubrication systems- dry sum, wet sum and mist sum lubrication, crank case ventilation (Globe eye), SAE viscosity index.

Ignition System – battery, magneto and electronic ignition system, comparison, different starting system used in automobiles

Unit IV: Drive train and vehicle performance [7]

Types of clutches, single plate, multiplate centrifugal clutches, clutch operating systems, Wet clutches, fluid coupling, clutch plate material Functions of gear box, various resistances to motion, rolling air and radiant 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

Unit V: Suspension and steering system **[7]**

Suspension Systems- Objects of suspension, principles of suspension design spring and unspring mass, types of springs, torsion bars, rubber springs, shock absorbers, independent suspension air suspension, interconnected suspension, hydro pneumatic suspension, self leveling suspension

Steering Systems-Requirements of good steering systems, steering geometry camber, steering axis inclination, included angle, scrub radius, castor, toe in, toe out, turning radius wheel balancing, steering linkages, steering gears, cornering force, slip angles under steer, over steer, types of wheels cross ply and radial tires, tubeless tires power steering

Unit VI: Braking system and Automobile maintenance **[7]**

Braking systems -used in automobiles Braking systems used in automobiles layout and working antiskid braking (ABS)

Automobile maintenance -Preventive maintenance Troubleshooting and diagnosis for Clutch &

Gear Box Troubleshooting and diagnosis for Brake and Steering Troubleshooting and diagnosis for Suspension

Text Books

1. Ganesan V., "Internal Combustion Engines", Tata McGraw Hill Publishing Company Ltd, Ninth Edition, New Delhi, 1995.
2. Mathur M.L., and Sharma R. P., "A course in I.C. Engine", Dhanpat Rai Publication, Seventh Edition, New Delhi, 1999.
3. Singh Kirpal, "Automobile Engineering – Vol II", New Chand Jain", Seventh Edition, Delhi, 1996.
4. Narang G. B. S., "Automobile Engineering", S. Chand and Company Ltd, Fifth Edition, Delhi, 1995.
5. Ballancy P. L., "Internal Combustion Engines", Khanna Publishers, Third Edition, New Delhi, 1991.

Reference Books

1. Heywood: Internal combustion Engine Fundamentals, Tata McGraw-Hill
2. Domkundwar & Domkundwar : Internal combustion Engine, Dhanpat rai
3. Joseph Heitner, "Automotive Mech

411094

ELECTIVE-IV (D): MECHATRONICS

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
In semester: 30 Marks
End semester: 70 Marks

Unit I: Introduction to Programmable Controllers [7]
Definition, A Historical Background, Principles of Operation, PLCs Versus Other Types of Controls PLC Product Application, Ladder Diagrams and the PLC Advantages of PLCs
Logic Concepts
The Binary Concept, Logic Functions, Principles of Boolean Algebra and Logic, PLC Circuits and Logic Contact Symbology
Processors, the Power Supply, and Programming Devices
Introduction, Processors, Processor Scan, Error Checking and Diagnostics, The System Power Supply, Programming Devices

Unit II: The Discrete Input/ Output System (8)
Introduction to Discrete I/O Systems, I/O Rack Enclosures and Table Mapping, Remote I/O Systems, PLC Instructions for Discrete Inputs, Types of Discrete Inputs, PLC Instructions for Discrete Outputs, Discrete Outputs, Discrete Bypass/Control Stations, Interpreting I/O, Specifications, Summary of Discrete I/O

Unit III: The Analog Input / Output System (8)
Overview of Analog Input Signals, Instructions for Analog Input Modules, 7-3 Analog Input Data Representation, Analog Input Data Handling, Analog Input Connections Overview of Analog Output Signals, Instructions for Analog Output Modules, Analog Output Data Representation, Analog Output Data Handling, Analog Output Connections Analog Output Bypass/Control Stations

Unit IV: Special Function I/O and Serial Communication Interfacing (8)
Introduction to Special I/O, Special Discrete Interfaces, Special Analog, Temperature, and PID Interfaces, Positioning Interfaces, ASCII, Computer, and Network Interfaces, Fuzzy Logic Interfaces, Peripheral Interfacing

Unit V: Programming Languages (8)
Introduction to Programming Languages, Types of PLC Languages, Ladder Diagram Format, Ladder Relay Instructions, Ladder Relay Programming, Timers and Counters, Timer Instructions, Counter Instructions, Program/Flow Control Instructions, Arithmetic Instructions, Data Manipulation Instructions, Data Transfer Instructions.

Unit VI: Data Measurements and Transducers (8)
Basic Measurement Concepts, Interpreting Errors in Measurements, Transducer Measurements, Thermal Transducers, Displacement Transducers, Pressure Transducers, Flow Transducers, Vibration Transducers (Any two)

Text Books:

1. Brayan L.A., Brayan E.A., "Programmable Controllers Theory and Implementation", Industrial Text Company Publication
2. Keith Clements, Jeffcoat J.W., "The PLC workbook: programmable logic controllers made easy", Prentice Hall, 1996.
3. Peter Rohner, "Automation with Programmable Logic Controllers", UNSW Press, 1996.
4. Bolton W., "Programmable Logic Controllers", 5th Edition, Newnes Publications, 2009.

Reference Books:

1. Clarence T. Jones, "Programmable Logic Controllers: The Complete Guide to the Technology", Brilliant-Training Publications, 1996.
2. Andrew Parr E., "Programmable Controllers: An Engineer's Guide", 3rd Edition, Elsevier Publications, 2003.
3. James Rehg A., Glenn Sartori J., Programmable Logic Controllers"; Prentice Hall, 20

411095

COMPUTER INTEGRATED DESIGN & MANUFACTURING

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Practical: 50 Marks

Practical work

The term work shall consist of Practical assignments based on the following topics. Evaluation of practical will be based on oral examination.

1. Construction of parametric solid model of any machine elements using software package.
2. Programming on CNC Lathe/Milling.
3. Programming on Robot application.
4. Study of Flexible Manufacturing Systems.
5. Study of Manufacturing Resource Planning.
6. Simulation of a simple mechanical system

411096

PRODUCT DESIGN & DEVELOPMENT

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Oral: 50 Marks

Oral will be based on any six assignments from following;
1. Morphological analysis of product design
2. Quality Function Deployment (QFD) and House of Quality
3. Case study based on product design approach
4. Case study of FMEA
5. Product Tear Down approach in product design
6. Design for 'X'
7. Case study in Product Life cycle Management (PLM)
8. Case study on identification of customer needs for specific product

411097

ELECTIVE III (A): MATERIALS AND LOGISTIC MANAGEMENT

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on one assignment on each unit.

4110947

ELECTIVE III (B): FINITE ELEMENT ANALYSIS

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term Work:

The term work shall consist of record of any three from 1 to 4 (C/MATLAB programs) and any three from 5 to 8 assignments of the problems based on following topics:

1. Computer program for axial bar subjected to axial forces.
2. Computer program for truss subjected to plane forces.
3. Computer program for beams subjected to transverse forces and moments.
4. Computer program for frames subjected to transverse forces and moments.
5. Stress and deflection analysis of two dimensional truss using FEA software.
6. Stress and deflection analysis of any machine component consisting of 2-D elements
7. using FEA software.
8. Stress and deflection analysis of any machine component consisting of 3-D elements
9. using FEA software.
10. Modal analysis of any machine components.

411097

ELECTIVE III (C): WORLD CLASS MANUFACTURING

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on one assignment on each unit.

411097

ELECTIVE III (D): INDUSTRIAL RELATIONS AND HUMAN RESOURCES

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on one assignment on each unit.

411098

ELECTIVE IV (A): INDUSTRIAL ROBOTICS

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term Work

The term work shall be based on the following assignments

1. Study of configuration of robots and motion of robot manipulator
2. Study of direct kinematics and inverse kinematic solutions (Numerical Problems)
3. Study of robot grippers (includes the problems based on gripper force)
4. Study of machine vision system
5. Study of robot drives and control
6. Study of robot interfacing with PC
7. Study on advanced industrial applications of robots
8. Programming the robot for pick and place operation

411098

ELECTIVE IV (B): SIMULATION AND MODELING

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on one assignment on each unit.

411098

ELECTIVE IV (C): AUTOMOBILE ENGINEERING

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term Work

The term work shall be based on any Six of the following assignments

1. Study of fuel injection systems for SI and CI engines.
2. Study of cooling systems in an automobile.
3. Study of ignition systems in an automobile.
4. Study of different types of clutches.
5. Study of transmission system in an automobile.
6. Study of wheel alignment.
7. Study of different types braking system.
8. Study of independent suspension system.
9. Study of preventive maintenance, trouble shooting for clutch, steering, brake, suspension and gear box systems in an automobile.

411098

ELECTIVE IV (D): MECHATRONICS

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term work: 50 Marks

Term work will be based on six assignments on the above syllabus and any six of following practical:

1. Study of switches and relays
2. Development of ladder diagram and simulation
3. PLC circuit and Logic contact symbology
4. Study of load cell trainer
5. Study of data acquisition system
6. Calibration of flow meter
7. Calibration of thermocouple
8. Verification of PID control system
9. Study of lever measurement trainer
10. Displacement measurement using LVDT

The practical may involve the use of automation and simulation software for preparation of ladder diagram and PLC circuit.

411099

PROJECT WORK

Teaching Scheme	**Examination Scheme**
Tutorial: 06 hrs/week	Term work: 50 Marks
	Oral: 100 marks

The student shall take up a suitable project, the scope of the project shall be such as to complete it within the time schedule, the term work shall consist of:

1. Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hi-tech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Above work shall be taken up individually or in groups. *The group shall not be more than 4 students,*

OR

Extensive analysis of some problems done with the help of a computer individually or in a group not exceeding two students.

2. A detailed report on the work done shall include project specification, design procedure, drawings, process sheets, assembly procedure and test results etc. Project may be of the following types:

i. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
ii. Improvement of existing machine / equipment / process.
iii. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
iv. Computer aided design, analysis *of* components such as stress analysis.
v. Problems related to Productivity improvements/Value Engineering/Material Handling Systems
vi. Energy Audit of an organization, Industrial evaluation of machine devices.
vii. Design of a test rig for performance evaluation of machine devices.
viii. Product design and development.
ix. Analysis, evaluation and experimental verification of any engineering problem encountered.
x. Quality systems and management. Total Quality Management.
xi. Quality improvements, In-process Inspection, Online gauging.
xii. Low cost automation, Computer Aided Automation in Manufacturing.
xiii. Time and Motion study, Job evaluation and Merit rating
xiv. Ergonomics and safety aspects under industrial environment
xv. Management Information System.
xvi. Market Analysis in conjunction with Production Planning and Control.

OR

Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. When a group of students is doing a project, names of all the students shall be included on every certified report copy.

Two copies of Seminar Report shall be submitted to the college. The students shall present their Project Phase-I report. before the examiners . The oral examination, shall be based on the term work submitted and jointly conducted by an internal and an; external examiner from industry, at the end of second semester. Format of the project report should be as follows:

1. Paper: The Project report should be typed/printed on white paper of A-4 size.
2. Typing: The typing shall be with one and half spacing and on one side of the paper.
3. Binding: The Industrial Implant Report should be submitted with front and back cover in black Hard bound, with golden embossing.
4. Margins: Left - 1.25", Right - 1". Top and Bottom 1"
5. Sequence of Pages:

1. Title page
2. Certificate form Institute
3. Completion Certificate form Industry, if sponsored.
4. Acknowledgement
5. Abstract
6. Index
7. Nomenclature and Symbols
8. Actual Content
9. Conclusion
10. References.

6. Front cover: The front cover shall have the following details in block capitals

i. Title at the top.
ii. Name of the candidate in the centre, and
iii. Name of the Institute, Name of Industry, if sponsored and the year of submission on separate lines, at the bottom.

7. Blank sheets: No blank sheets be left anywhere in the report.
8. Project Completion Certificate:

The approval sheet follows the title sheet and shall be as shown with proper spacing.

CERTIFICATE

This is to certify that Mr. /Ms ……(Name)……has carried out a Project entitled, ……during the course of his training at……..in partial fulfillment of the requirement of the B.E. Production Engineering Course of University of Pune at ……during the academic Year ……

Date: (Guide)
Place:

(Examiner) (Head of Department)