PEOPLE'S UNIVERSITY, BHOPAL

Programme: **B. Tech. (Mechanical Engineering)** **Semester -VII**

Subject Title	Subject Code	Credits			Theory		
		L	T	P	External (70)	Internal (30)	Total (100)
Robotics and Industrial Automation	MET-701	3	1	-			Min: 40 (D Grade)

Duration of Theory (External): 3 Hours
Theory Internal - Max Marks: 30
Best of Two Mid Semester Test –Max Marks: 20
Assignment / Quiz – Max. Marks: 10

Unit	Contents (Theory)
I	**Introduction:** Need and importance, basic concepts, structure and classification of industrial robots, terminology of robot motion, configuration, anatomy, specifications of robot system, applications. **End Effectors and Drive systems**: Drive systems for robots, salient features and comparison, different types of end effectors, design, and applications.
II	**Sensors:** Classifications, features, characteristics, types, piezoelectric, linear position, displacement, proximity, tactile, vision, voice, optical ,range, sensors, encoders, image processing & object recognitions, types of Robot Programming method**,** programming concepts and types of programming languages, applications. **Safety and Economy of Robots**: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots.
III	**Automation:** Introduction, Types, Levels, Advantages, Limitations, Strategies, Future of Industrial Automation, Design Process, Product Life Cycle; Design For Manufacturing, And Concurrent Engineering; Product Design in Conventional And CIM Environment; Terms i.e.. CAD, CAE, CAM, CAP, CAPP, CATD, MRP And CAQ.
IV	**Group Technology:** Definition, Principle, Advantages, Limitations, Applications Of Group Technology, Cellular Manufacturing System, Part Family, Automated Guided Vehicle, Automated Storage And Retrieval System, Digital Manufacturing, Reverse Engineering.
V	**Modern Production Technology:** Introduction, Definition, Principle, Advantages, Limitations, Applications of Flexible Manufacturing System, Lean Productions and design for six-sigma, Agile Production, Artificial Intelligence, Intelligent Machine Tool, Smart Machines and Expert System For Manufacturing, Virtual Manufacturing, Green Manufacturing, Rapid Prototype.

References:

1. K. Shimon; Handbook of Industrial Robots; John Wiley & Sons.
2. R. K. Mittal, Nagrath; Robotics and Control; TMH
3. Bhupendra Gupta, Raji N.Mishra; Veerendra Kumar,Industrial Robotics, Dhanpat Rai, New Delhi.
4. Groover M.P; CAM and Automation; PHI Learning
5. P.N.Rao, CAM/CAD principle & Applications- - Tata McGraw Hill.
6. R.K. Jain, Production Technology, Khanna Publishers.

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Subject Title	Subject Code	Credits			Theory		
		L	T	P	External (70)	Internal (30)	Total (100)
Value Engineering	MET-7101	3	1	-			Min: 40 (D Grade)

Duration of Theory (External): 3 Hours
Theory Internal - Max Marks: 30
Best of Two Mid Semester Test -Max Marks: 20
Assignment / Quiz - Max. Marks: 10

Unit	Contents (Theory)
I	**Value Engineering Concepts:** Advantages, applications in product development, process improvement, service improvement and system design, problem recognition, role in productivity, criteria for comparison, elements of choice.
II	**Analysis of Functions:** Anatomy of function; Values: Use, antique, cost, esteem and exchange; Primary versus secondary versus tertiary/unnecessary functions; Functional Analysis: Function Analysis System Technique and quantitative evaluation of ideas, case studies.
III	**Value Engineering Techniques:** Selecting products and operations for VE action, timing; VE programmes, determining and evaluating functions, assigning rupee equivalents, developing alternate means to required functions, decision making for optimum alternative, Queuing theory and Monte Carlo method, make or buy, Measuring profits, Reporting results, Follow up, Use of advanced technique like FAST, use of decision matrix, make or buy decisions, measuring profits, reporting results and follow up
IV	**Implementation:** Action plan, record progress, report progress, review meetings, problems in implementation, human factors
V	**Managing VE:** Level of VE in the organization, size and skill of VE staff, small plant VE activity management supports; Audit of savings.

References:

1 Techniques of Value analysis and engineering – Miles, Pub.- McGraw Hill.
2 Value Management – Heller Pub.- Addison Wesley.
3 Value Analysis and Value – Oughson, Pub.- Pitman.

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Subject Title	Subject Code	Credits			Theory		
		L	T	P	External (70)	Internal (30)	Total (100)
Computer Aided Engineering	MET-7102	3	1	-			Min: 40 (D Grade)

Duration of Theory (External): 3 Hours
Theory Internal - Max Marks: 30
Best of Two Mid Semester Test -Max Marks: 20
Assignment / Quiz - Max. Marks: 10

Unit	Contents (Theory)
I	**Introduction:** Methods to solve engineering problems- analytical, numerical, experimental, their merits and comparison, Computer Aided Engineering (CAE) and design, chain, stages vs concurrent-collaborative design cycles, computer as enabler for concurrent design , Structural analysis, objectives, static, Dynamic and kinematics analyses, Basic steps in finite element problem formulation, General applicability of the method ,discretization into smaller elements and effect of size/ shape on accuracy, importance of meshing, boundary conditions, degree of freedom (DOF).
II	**Element Types and Characteristics:** Types of analysis in CAE, static (linear/ non linear), dynamic, buckling, thermal, fatigue, crash NVH and CFD, Basic element shapes, Aspect ratio, Shape functions, Generalized co-ordinates and nodal shape functions; ID bar and beam elements, 2D rectangular and triangular elements; axis-symmetric elements , meshing in elements and length of elements.
III	**Assembly of Elements and Matrices:** Concept of element assembly, Global and local coordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, force stiffness and displacement matrix, Rayleigh-Ritz and Galerkin method, FEM; analytical and FEM solution for single rod element and two rod assembly. Solution of simultaneous equations, Gaussian elimination and Choleksy decomposition methods, Numerical integration, One and 2D applications.
IV	**Static Analysis:** Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations
V	**Dynamic Analysis:** Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation of mass matrices for ID elements, Determination of natural frequencies and mode shapes, Use of commercial software packages.

References:

1. Fundamentals of finite Element Analysis by David Hutton.
2. Finite element in engineering by T.R. Chandrapatla and Belegundu.
3. Concepts and applications of Finite element analysis by Cook, Malkus, Plesha and Witt.
4. The Finite element Method, A Practical course, Liu and Quek.
5. The Finite element Method in Engineering by S.S. Rao.
6. Krishnamurthy; Finite Element Analysis, theory and programming; TMH
7. Finite Element Analysis; Buchanan; Schaum series; TMH
8. Textbook of Finite Element Analysis; Seshu P; PHI.
9. Introduction to finite element Method; Desai Chandrakan S et al; CBS Publications

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Subject Title	Subject Code	Credits			Theory		
		L	T	P	External (70)	Internal (30)	Total (100)
Automobile Engineering	**MET - 7103**	3	1	-			Min: 40 (D Grade)

Duration of Theory (External): 3 Hours
Theory Internal - Max Marks: 30
Best of Two Mid Semester Test -Max Marks: 20
Assignment / Quiz - Max. Marks: 10

Unit	Contents (Theory)
I	**Chassis & Body Engineering:** Types, Technical details of commercial vehicles, types of chassis, layout, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive
II	**Steering System:** Front axle beam, stub axle, front wheel assembly, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe-out, condition for true rolling motion, centre point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears. **Emission standards and pollution control:** Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control.
III	**Transmission System:** Function and types of clutches, single plate, multi-plate clutch, roller & spring clutch, clutch lining and bonding, double declutching, types of gear Boxes, synchroniser, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction.
IV	**Suspension system** : Basic suspension movements, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-Energisation, air bleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres & tubes.
V	**Electrical and Control Systems:** Storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, Lighting system, head light dazzling, signalling devices, battery operated vehicles, choppers. Importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems.

References:

1. Crouse, Automotive Mechanics TMH.
2. Srinivasan S; Automotive engines; TMH
3. Gupta HN; Internal Combustion Engines; PHI;
4. Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.
5. Kripal Singh, Automotive Engineering Khanna Pub.
6. Newton &Steeds , Automotive Engineering
7. Emission standards from BIS and Euro –I and Euro-III

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Programme: **B. Tech. (Mechanical Engineering)** **Semester -VII**

Subject Title	Subject Code	Credits			Theory			Practical		
		L	T	P			Total (100)			Total (50)
Industrial Engineering and Operation Research	**MET-703**	3	1	2	**External (70)**	**Internal (30)**	Min: 40 (D Grade)	**External (35)**	**Internal (15)**	Min: 20 (D Grade)

Duration of Theory (External): 3 Hours

Theory Internal - Max Marks: 30

Best of Two Mid Semester Test –Max Marks: 20

Assignment / Quiz – Max. Marks: 10

Practical Internal - Max Marks: 15

Lab work & Sessional –Max Marks: 10

Assignment / Quiz – Max. Marks: 05

Unit	Contents (Theory)
I	**Industrial Engineering:** Definition, development, Object, Contribution & function of Industrial Engineering, Place of Industrial engineering in an organization, Management Ergonomics, Objectives and need for maintenance, Types of maintenance, Breakdown, Predictive and Preventive Maintenance, Condition based maintenance system. Equipment replacement policy: Reasons, Deterioration, Obsolescence, Depreciation, Methods for depreciation calculation. Value Engineering; Definition, Objectives & use of value analysis, Application & techniques.
II	**Work Study:** Introduction and definition of Work-study, Productivity and work study, Prerequisites of conducting a work study. **Method Study:** Introduction, definition, procedure, Recording techniques, Flow Process Charts, Critical examination by questioning technique, man-machine chart, Motion economy principles, Micro motion study –Therbligs. **Work Measurement:** Definition, Objectives, Techniques of Work measurement, Selection & timing the job, Rating, Allowances, Normal and standard time determination, Work sampling.
III	**Operations Research:** Introduction: Definition and Development of Operations Research, Necessity and scope of Industry, Decision making, OR models, application, Difficulties and Limitation of OR, Linear Programming Maximization and minimization of function with or without Constraints, Formulation of a linear programming problem, Graphical method and Simplex method, Big M method, Two phase method, Degeneracy, Application of Linear Programming in Mechanical Engineering.
IV	**The Transportation Problems:** Mathematical formulation, Stepping stone method, Modified Distribution Method, Vogel's Approximation Method, Solution of balanced and unbalanced transportation problems and case of Degeneracy. **Assignment Problems:** Mathematical formulation of assignment problems, Solution of assignment problems, Travelling salesman problems, Air crew Assignment problems.
V	**Network Analysis:** CPM/PERT, Network Representation, Techniques for drawing network, Resource smoothing and levelling, Project cost, Optimum project duration, Project crashing, Updating, Time estimation in PERT.

References:

1. Industrial Engineering and Production Management - Martand Telsang – S Chand & Company
2. Industrial Engineering & Management –A new perspective, Philip E Hicks, Mcgraw Hill
3. Comprehensive Industrial Engineering- N.J. Manek --- Laxmi Publication (P) Ltd.
4. Industrial Engineering and Management Systems – S. Dalela, Mansoor Ali: Standard Publishing
5. Operation Research, Hira & Gupta – S. Chand & Co.
6. Industrial Engineering & management, O.P.Khanna

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List of Experiments (Expandable/Suggested):

1. Peg board experiment
2. Stop watch time study
3. Performance rating exercise
4. Graphic tools for method study
5. Work sampling
6. MTM practice
7. Study of physical performance using tread mill and Ergo cycle
8. Physical fitness testing of individuals
9. Experiments using sound level and lux meters
10. To solve different Problems by graphical and analytical methods contained in the syllabus. Different programming software may be used.

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Subject Title	Subject Code	Credits			Theory			Practical		
		L	T	P	External	Internal	Total (100)	External	Internal	Total (50)
Control System and Electricals Machines	MET-704	3	1	2	(70)	(30)	Min: 40 (D Grade)	(35)	(15)	Min: 20 (D Grade)

Duration of Theory (External): 3 Hours

Theory Internal - Max Marks: 30

Best of Two Mid Semester Test –Max Marks: 20

Assignment / Quiz – Max. Marks: 10

Practical Internal - Max Marks: 15

Lab work & Sessional –Max Marks: 10

Assignment / Quiz – Max. Marks: 05

Unit	Contents (Theory)
I	**Systems:** Continuous/Discrete, Time-invariant/Time-varying, Linear/Nonlinear, Open loop/Closed loop, Effects of negative feedback, Transfer Functions – (example: R-L-C series circuit or equivalent), Order and type of transfer functions, Block diagram representation of systems (example: D.C. motor or equivalent), Block diagram algebra.
II	**Signal Flow graph:** Time and frequency domain specifications, Transient Analysis of standard first and second order systems with unity feedback, Transient and steady state errors – definitions, Error constants.
III	**Stability:** Routh Hurwitz Criteria and Nyquist stability criterion, Relative stability: Siginificance of Gain margin and phase margin, Construction of Root locus, Bode plots and Polar plots, Minimum/Non-minimum phase systems, Transportation lag, Pade approximation.
IV	**Case Studies:** Effect of P, PI, PD and PID control, Effects of Lead and lag compensation time domain and frequency domain analysis, Effect of tacho-generator feedback.
V	**Control system components:** Potentiometers, Synchros, Tachogenrators, A.C.and D.C. Servomotors, Gyroscope.

References:

1. M. Gopal, Control Systems Principles and Design, Second Edition, Tata McGraw Hill 2002.
2. Benjamin C. Kuo, Automatic Control Systems, 7th Edition, Prentice Hall of India, 1995.
3. Naresh K. Sinha, Control Systems, CBS college Publishing, 1986.

List of Experiments (Expandable/Suggested):

List of experiments contained from all five units of syllabus.

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Subject Title	Subject Code	Credits			Practical		
		L	T	P	External	Internal	Total (50)
Mechanical Engineering Software Lab- III	**MET-705**	-	-	2	**(Nil)**	**(50)**	Min: 20 (D Grade)

Practical Internal - Max Marks: 50

Lab Performance, Lab Record & Viva –Max Marks: 45
Assignment / Quiz – Max. Marks: 05

Contents (Practical)
Solid Modeling Software: In this lab student will get an opportunity to learn any one solid modeling software from Autodesk Inventor, Pro/ENGINEER, CATIA, SOLID EDGE, SOLID WORKS, UNIGRAPHICS etc as assigned by the faculty. Students will be required to learn the methods related to Sketching, part modeling, assembly, wireframe / surfacing modeling & Drafting of various mechanical components.

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Programme: **B. Tech. (Mechanical Engineering)** **Semester -VII**

Subject Title	Subject Code	Credit			Practical		
		L	T	P	External (105)	Internal (45)	Total (150)
Major Project – I	MET-706	-	-	6			Min: 60 (D Grade)

Practical Internal - Max Marks: 45

Lab Performance, Lab Record & Viva –Max Marks: 40

Assignment / Quiz – Max. Marks: 05

Contents (Practical)

The Major Project Work provides students an opportunity to do something on their own and under the supervision of a guide. Each student shall work on an approved project, which should be selected from some real life problem as far as possible, which may involve fabrication, design or investigation of a technical problem. The project work involves sufficient work so that students get acquainted with different aspects of manufacturing, design or analysis. The student also have to keep in mind that in final semester they would be required to implement whatever has been planned in the major project in this semester. It is possible that a work, which involves greater efforts and time, may be taken up at this stage and finally completed in final semester, but partial completion report should be submitted in this semester and also evaluated internally. At the end of semester, all students are required to submit a synopsis.

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Programme: **B. Tech. (Mechanical Engineering)** **Semester -VII**

Subject Title	Subject Code	Credits			Practical		
		L	T	P	External (70)	Internal (30)	Total (100)
Industrial Training II	MET- 707	-	-	4			Min: 40 (D Grade)

Practical Internal - Max Marks: 30

Lab work & Sessional – Max Marks: 25

Assignment / Quiz – Max. Marks: 05

Contents (Practical)

OBJECTIVE OF INDUSTRIAL TRAINING

The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World of Work and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final Year.

Industrial training of the students is essential to bridge the wide gap between the classroom and industrial environment. This will enrich their practical learning and they will be better equipped to integrate the practical experiences with the classroom learning process.