Scheme & Syllabus of

UNDERGRADUATE DEGREE COURSE

B.Tech. VII & VIII Semester

Mechatronics Engineering

Rajasthan Technical University, Kota

Effective from session: 2020 – 2021

Teaching & Examination Scheme
B.Tech.: Mechatronics Engineering
4th Year – VII Semester

SN	Category	Course Code	Course Title	Contact hrs/week L	T	P	Marks Exm Hrs	IA	ETE	Total	Cr
THEORY											
1	PEC	7MH5-11	Design of Mechatronics System	3	0	0	3	30	120	**150**	**3**
		7MH5-12	Robotics and Machine Vision System								
		7MH5-13	Medical Electronics								
2	OE		Open Elective - I	3	0	0	3	30	120	**150**	**3**
			Sub Total	**6**	**0**	**0**		**60**	**240**	**300**	**6**
PRACTICAL & SESSIONAL											
3	PCC	7MH4-20	Computer Aided Design & Computer Aided Manufacturing Lab	0	0	3	2	45	30	**75**	**1.5**
4		7MH4-21	Robotics Laboratory	0	0	2	2	30	20	**50**	**1**
5		7MH4-22	Modelling & Simulation Lab	0	0	3	2	45	30	**75**	**1.5**
6	PSIT	7MH7-30	Industrial Training *	1	0	0		75	50	**125**	**2.5**
7		7MH7-40	Seminar *	2	0	0		60	40	**100**	**2**
8	SODECA	7MH8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0		0	25	**25**	**0.5**
			Sub- Total	**3**	**0**	**8**		**255**	**195**	**450**	**9**
			TOTAL OF VII SEMEESTER	**9**	**0**	**8**		**315**	**435**	**750**	**15**

*for the purpose of counting teaching load

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

Teaching & Examination Scheme
B.Tech.: Mechatronics Engineering
4th Year – VIII Semester

SN	Category	Course Code	Course Title	Contact hrs/week L	T	P	Marks Exm Hrs	IA	ETE	Total	Cr
THEORY											
1	PEC	8MH5-11	Signal Processing & Data Acquisition System	3	0	0	3	30	120	**150**	**3**
		8MH5-12	Artificial Intelligence								
		8MH5-13	Product Development & Launching								
2	OE		Open Elective - II	3	0	0	3	30	120	**150**	**3**
			Sub Total	**6**	**0**	**0**		**60**	**240**	**300**	**6**
PRACTICAL & SESSIONAL											
	PCC	8MH4-20	Signal Processing Lab	0	0	2	2	30	20	**50**	**1**
4		8MH4-21	Mechanical Vibration Lab	0	0	2	2	30	20	**50**	**1**
5	PSIT	8MH7-50	Project *	3	0	0		210	140	**350**	**7**
6	SODECA	8MH8-00	Social Outreach, Discipline & Extra Curricular Activities					0	25	**25**	**0.5**
			Sub- Total	**3**	**0**	**4**		**270**	**205**	**475**	**9.5**
			TOTAL OF VIII SEMEESTER	**9**	**0**	**4**		**330**	**445**	**775**	**15.5**

*for the purpose of counting teaching load

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ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

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Rajasthan Technical University, Kota

List of Open Electives for Mechatronics Engineering			
Subject Code	**Title**	**Subject Code**	**Title**
Open Elective - I		**Open Elective - II**	
7AG6-60.1	Human Engineering and Safety	8AG6-60.1	Energy Management
7AG6-60.2	Environmental Engineering and Disaster Management	8AG6-60.2	Waste and By-product Utilization
7AN6-60.1	Aircraft Avionic System	8AN6-60.1	Finite Element Methods
7AN6-60.2	Non-Destructive Testing	8AN6-60.2	Factor of Human Interactions
7CH6-60.1	Optimization Techniques	8CH6-60.1	Refinery Engineering Design
7CH6-60.2	Sustainable Engineering	8CH6-60.2	Fertilizer Technology
7CR6-60.1	Introduction to Ceramic Science & Technology	8CR6-60.1	Electrical and Electronic Ceramics
7CR6-60.2	Plant, Equipment and Furnace Design	8CR6-60.2	Biomaterials
7CE6-60.1	Environmental Impact Analysis	8CE6-60.1	Composite Materials
7CE6-60.2	Disaster Management	8CE6-60.2	Fire and Safety Engineering
7CS6-60.1	Quality Management/ISO 9000	8CS6-60.1	Big Data Analytics
7CS6-60.2	Cyber Security	8CS6-60.2	IPR, Copyright and Cyber Law of India
7EE6-60.1	Electrical Machines and Drives	8EE6-60.1	Energy Audit and Demand side Management
7EE6-60.2	Power Generation Sources.	8EE6-60.2	Soft Computing
7EC6-60.1	Principle of Electronic communication	8EC6-60.1	Industrial and Biomedical applications of RF Energy
7EC6-60.2	Micro and Smart System Technology	8EC6-60.2	Robotics and control
7MI6-60.1	Rock Engineering	8MI6-60.1	Experimental Stress Analysis
7MI6-60.2	Mineral Processing	8MI6-60.2	Maintenance Management
7PE6-60.1	Pipeline Engineering	8PE6-60.1	Unconventional Hydrocarbon Resources
7PE6-60.2	Water Pollution control Engineering	8PE6-60.2	Energy Management & Policy
7TT6-60.1	Technical Textiles	8TT6-60.1	Material and Human Resource Management
7TT6-60.2	Garment Manufacturing Technology	8TT6-60.2	Disaster Management

7MH5-11: Design of Mechatronics System

Credit: 3 **Max. Marks: 150 (IA: 30, ETE: 120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Fundamentals:** Introduction to Mechatronics system- key element Mechatronics Design process- Types of design-Design Parameter-Traditional and Mechatronics designs- Advanced approaches in Mechatronics-Industrial design and ergonomics, safety	8
3	**System Modelling:** Introduction-model categories-fields of application-model development-model verification-model validation-model simulation-design of mixed systems-electro mechanics design-model transformation-domain-independent description forms simulator coupling	8
4	**System Interfacing:** Introduction-selection of interface cards-DAQ card-single channel-multichannal-RS232/422/485 communication- IEEE 488 standard interface-GUI card-GPIB-Ethernet switch -Man machine interface.	8
5	**Case Studies of Mechatronics System:** Introduction-Fuzzy based Washing machine-pH control system- Autofocus Camera, exposure control-Motion control using D.C.Motor & Solenoids-Engine management systems. Controlling temperature of a hot/cold reservoir using PID-Control of pick and place robot- Part identification and tracking using RFID – Online surface measurement using image processing.	10
6	**Micro Mechatronic System:** Introduction- System principle - Component design – System design-Scaling laws- Micro actuation- Micro robot- Micro pump - Applications of micro mechatronic components.	5
	TOTAL	40

7MH5-12: Robotics and Machine Vision System

Credit: 3 **Max. Marks: 150 (IA: 30, ETE: 120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Basics of Robotics**: Introduction- Basic components of robot-Laws of robotics- classification of robot-work space- accuracy-resolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives	8
3	**Robot End Effectors:** Robot End effectors: Introduction- types of End effectors- Mechanical gripper types of gripper mechanism- gripper force analysis- other types of gripper ,special purpose grippers	7
4	**Robot Mechanics:** Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics- Lagrange - Euler formulation- Newton - Euler formulation	8
5	**Machine Vision Fundamentals:** Machine vision, image acquisition, digital images-sampling and quantization levels of computation Feature extraction-windowing technique- segmentation Thresholding- edge detection- binary morphology - grey morphology	8
6	**Robot Programming** Robot programming: Robot Languages- Classification of robot language Computer control and robot software-Val system and Languages- application of robots.	8
	TOTAL	40

7MH5-13: Medical Electronics

Credit: 3 **Max. Marks: 150 (IA: 30, ETE: 120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Bio-Medical Electrode Sensors**: Cell structure - electrode - electrolyte interface, electrode potential, resting and action potential- electrodes for their measurement, ECG, EEG, EMG - machine description - methods of measurement – three equipment failures and trouble shooting.	8
3	**Transducers for Bio-Medical Instrumentation**: Basic transducer principles Types - source of bioelectric potentials - resistive, inductive, capacitive, fibre-optic, photoelectric and chemical transducers - their description and feature applicable for biomedical instrumentation - Bio & Nano sensors & application	8
4	**Signal Conditioning**: Recording and Display Input isolation, DC amplifier, power amplifier, and differential amplifier-feedback, Op-Amp electrometer amplifier, carrier Amplifier- instrument power supply. Oscillographic - galvanometric-X-Y, magnetic recorder, storage oscilloscopes - electron microscope - PMMC writing systems - Telemetry principles- Bio telemetry.	8
5	**Medical Support**: Electrocardiograph measurements–blood pressure measurement: by ultrasonic method- plethysonography-blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method- phonocardiography-vector cardiography. Heart lung machine - artificial ventilator - Anaesthetic machine - Basic ideas of CT scanner - MRI and ultrasonic scanner - Bio-telemetry - laser equipment and application- cardiac pacemaker- DC- defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.	10
6	**Bio-Medical Diagnostic Instrumentation**: Introduction- computers in medicine- basis of signal conversion and digital filtering data reduction technique- time and frequency domain technique- ECG Analysis.	5
	TOTAL	40

7MH4-20: Computer Aided Design & Computer Aided Manufacturing Lab

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
0L+0T+3P

SN	Contents
1	Design and assemble the following machine elements using Pro-E / CATIA / UNIGRAPHICS **(i)** Plummer Block **(ii)** Screw Jack **(iii)** Lathe Tailstock **(iv)** Universal Coupling **(v)** Machine Vice **(vi)** Stuffing box
2	NC code generation using Master CAM (MILL) or any CAM package for following Machine operation. **(i)** Linear Cutting. **(ii)** Circular cutting. Cutter Radius Compensation
3	NC code generation using Master CAM (Lathe) or any CAM package for Lathe Operation of the following **(i)** Straight, Taper and Radius Turning. **(ii)** Thread Cutting. **(iii)** Rough and Finish Turning Cycle. **(iv)** Drilling and Tapping Cycle .

7MH4-21: Robotics Lab

Credit: 1 **Max. Marks: 50 (IA: 30, ETE:20)**
0L+0T+2P

SN	Contents
1	Study of different types of robots based on configuration and application.
2	Study of different type of links and joints used in robots.
3	Study of components of robots with drive system and end effectors.
4	Determination of maximum and minimum position of links.
5	Verification of transformation (Position and orientation) with respect to gripper and world coordinate system.
6	Estimation of accuracy, repeatability and resolution.
7	Robot programming exercises.

7MH4-22: Modelling and Simulation Lab

Credit: 1.5 **Max. Marks: 75 (IA: 45, ETE: 30)**
0L+0T+3P

SN	Contents
1	Computer Generation of Random Numbers.
2	Chi-square goodness-of-fit test.
3	One-sample Kolmogorov-Smirnov test
4	Test for Standard Normal Distribution
5	Testing Random Number Generators.
6	Monte-Carlo Simulation.
7	Simulation of Single Server Queuing System.
8	Simulation of Two-Server Queuing System.
9	Simulate and control a conveyor belt system
10	Two-sample Kolmogorov-Smirnov test.

8MH5-11: Signal Processing & Data Acquisition System

Credit: 3 **Max. Marks: 150 (IA: 30, ETE: 120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Signals and Systems**: Classification of signals, Continuous time signals and its classifications, Standard continuous time signals, Classification of continuous time systems, Discrete time signals and its classifications, Concept of frequency in discrete time signals, Standard discrete time signals, Discrete time systems, Classification of discrete time systems, Nyquist rate, Sampling theorem, Aliasing, Convolution.	9
3	**Fourier Transform:** Introduction, Condition for existence of Fourier Integral, Fourier Transform and its properties, Energy density and Power Spectral Density, Nyquist Theorem, System Analysis using Fourier Transform.	8
4	**Signal Conditioning:** Operational Amplifiers: application in instrumentation, Charge amplifier, Carrier amplifier, Introduction to active filters, Classification, Butterworth, Chebyshev filters, First order, Second order and higher order filters, Voltage to frequency and frequency to voltage converters.	8
5	**Signal conditioning and data acquisition:** Amplification – Filtering – Sample and Hold circuits –Data Acquisition: Single channel and multi channel data acquisition – Data Graphical Interface (GUI) Software for DAS, RTUs, PC-Based data acquisition system.	8
6	**Random Signals:** Introduction, Probability, Random variables, Gaussian distribution, Transformation of random variables, random processes, stationary processes, Correlation and Covariance Functions.	6
	TOTAL	40

8MH5-12: Artificial Intelligence

Credit: 3 **Max. Marks: 150 (IA: 30, ETE: 120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Brief Review of AI History:** Introduction to Artificial Intelligence, Course structure and policies, History of AI, Proposing and evaluating AI applications, task environment, agent architecture types.	8
3	**Search and knowledge representation**: Planning Problem spaces and search, Knowledge and rationality, Heuristic search strategies, Search and optimization (gradient descent), Adversarial search, Planning and scheduling, forward & backward chaining, genetic algorithm	9
4	**Probabilistic reasoning and uncertainty**: Bayes nets and reasoning with them,uncertainty and methods to handle it,knowledge Representation and Reasoning, Logic and inference, Bayesian Reasoning, Temporal reasoning.	9
5	**Learning**: Forms of learning , kernel, neural network models, noise and overfitting, decision trees, inductive learning, divisive algorithms based on similarity/dissimilarity measures.	8
6	**AI applications:** Applications to NLP, vision, robotics, etc.	5
	TOTAL	40

8MH5-13: Product Development & Launching

Credit: 3 **Max. Marks: 150 (IA: 30, ETE: 120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Importance of New Product:** Definition-importance-Development Process, Importance of new product for growth of enterprise, Definition of product and new product, Responsibility for new product development, Demands on product development team. Classification of products from new product development point of view- Need based/Market pull products, Tech. push, Platform based, Process based and customized products,New product development process and organization, Generic product development process for Market Pull Products, Modification of this process for other types of products.	10
3	**Need Analysis:** Problem Formulation Establishing economic existence of need, Need Identification and Analysis, Engineering Statement of Problem, Establishing Target Specification.	5
4	**Generation of Alternatives and Concept Selection:** Concept generation- a creative process, Creativity, Road Elects to creative thinking-Fear of criticism and Psychological set, 4 Tools of creativity like brain storming, Analogy, Inversion etc., Creative thinking Process, Concept feasibility and Concept Selection, Establishing Engineering Specification of Products.	8
5	**Preliminary and Detailed Design:** Design Review Preliminary DesignIdentification of subsystems, Subsystem specifications, Compatibility, Detailed design of subsystems, component design, Preparation of assembly drawings, Review of product design from point of view of Manufacturing, Ergonomics and aesthetics.	8
6	**Management of New Product:** Development and Launch New Product Management's Challenges, maintaining focus, Promotion of Right Culture, Management of Creativity, Top Management attention, Design Team Staffing and Organization, Setting key mile stone, Identification of Risk Areas, Project Execution and Evaluation Product Launch Strategies.	8
	TOTAL	40

8MH4-20: Signal Processing Lab

Credit: 1 **Marks: 50 (IA: 30, ETE:20)**
0L+0T+2P

SN	Contents
1	Generation of continuous and discrete elementary signals (periodic and non periodic) using mathematical expression.
2	Generation of Continuous and Discrete Unit Step Signal.
3	Generation of Exponential and Ramp signals in Continuous & Discrete domain.
4	Continuous and discrete time Convolution (using basic definition).
5	Adding and subtracting two given signals. (Continuous as well as Discrete signals)
6	Design digital IIR Butterworth filter- LPF & HPF.
7	Design digital IIR chebychev filter- LPF & HPF.
8	Op-amp as a comparator, Integrator and Differentiator.
9	Interfacing of sensors and transducers using DAQ cards.
10	Analysis of ECG.

8MH4-21: Mechanical Vibrations Lab

Credit: 1 **Marks: 50 (IA: 30, ETE:20)**
0L+0T+2P

SN	Contents
	Introduction to basic concepts of mechanical vibration: Free and forced vibration, natural frequency, resonance, undamped and damped system, longitudinal, torsional and flexural vibration systems, vibration parameters and their measurement etc
1	To verify relation T = 2 / (l/g) for a simple pendulum
2	To determine radius of gyration of compound pendulum.
3	To determine the radius of gyration of given bar by using bifilar suspension.
4	To determine natural frequency of a spring mass system.
5	Equivalent spring mass system.
6	To determine natural frequency of free torsional vibrations of single rotor system. i. Horizontal rotor ii. Vertical rotor
7	To verify the Dunkerley's rule.
8	Study of free damped torsional vibration to performing the experiment to find out damping co-efficient.
9	To conduct experiment of trifler suspension.
10	Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies.
11	Study of Vibration measuring instruments