SYLLABUS (CBCS)
OF
BACHELOR OF TECHNOLOGY
(B.TECH.) (MECHANICAL ENGINEERING)

Effective from
Session 2015-16

Department of Mechanical Engineering
Faculty of Engineering and Technology
Jamia Millia Islamia, New Delhi, INDIA

Contents

PREFACE

Mechanical Engineering is one of the prominent branches of Engineering and contributes vitally in building the modern society. JamiaMilliaIslamia realized the importance of this body of knowledge and a separate Department of Mechanical Engineering as part of the Faculty of Engineering and Technology was created in 1985.

We started the basic graduate program of Mechanical Engineering as B.Sc. Engineering (Mechanical). Then, this program has been upgraded as B. Tech. in Mechanical Engineering with enhanced focus on Technology. Presently this program is being offered along-with B. E. (Evening), M Tech (Mechanical Engineering, specialization in Thermal / Design / Industrial-Production) and a research Program leading to Ph.D.

Mechanical engineering as one of the widest disciplines and has given rises to many other branches of Engineering. Thus, its teaching involves extensive diversity. The input to this B. Tech program comes through an all India competition and one of the best students is only able to qualify the entrance test. These students have good understanding of physics, chemistry and mathematics. Keeping in view the good quality of students and rigorous teaching environment this syllabus has been designed for very good quality students and teachers who are willing to work hard and give strong focus to teaching learning process and want to contribute extensively to the nation building.

The syllabus of different courses has been designed keeping in view the future development in the area along-with developing a strong base of the subjects. Jamia has a location advantage and students can easily have excellent exposure to nearby industry and institutions. Thus, we have focused more on academic deliverance through which student is exposed, extensively to theoretical as well as practical aspects of the subjects.

The design, development and compilation of this program structure & syllabi have been truly a collective effort. It has benefited from the inputs received from many subjects' experts in various forms, from professors, industrialists, professionals, researchers, and students. In this endeavor, we have tried to address most of the concern raised by the stakeholders, in doing so; we have tried to relate the mechanical engineering with realistic world problem that the society faces now days. The syllabi are designed in such a way that they recommend the latest book of the respective areas, and emphasizing on developing the research capability in the students.

The departments in consultation with various stakeholders have formulated five Programme Educational Objectives (PEO's) and twelve Programme Outcomes (PO's). The course syllabi and the overall curriculum are designed to achieve these objectives and outcomes.

This revision has been taken with focus on integrating students to new development along-with strong foundation of subject knowledge. Further new laboratory and theory courses have

beenintroduced to improve the skill and employability of the student. New subjects as Mechatronics, Product design, Turbo machinery, Modern manufacturing, solar energy etc. have, introduced. All courses have been revised appropriately. Course objectives and outcomes have been properly documented and updated list of text and reference books is also provided.

To develop this program curricula & syllabus, area specific teams were made. These teams were headed by Prof. Mohd. Islam, Prof. M. M. Hassan, Prof. Z. A. Khan and Prof. Mohd.Suhaib. The special efforts of teachers of the department is laudable. They worked meticulously and with vision to obtain valuable inputs. Finally, I would like to thank the alumni, the well-wishers in Industry and academia who have been supportive and instructive in a variety of diverse ways over a period of time. We take great pleasure in placing this revised course structure and syllabi in the hand of different stakeholders.

This syllabus is outcome of the effort of the stakeholders; they have contributed extensively in making this futuristic document. Numerous people having different stakes have also assisted in the development and compilation of this syllabus. Some provided help in direct and concrete manner while other provided help in less direct and more supportive ways.

The Mechanical Engineering Department appreciated the hard work done by all the faculty members in redesigning, compiling the syllabi and sending their inputs, in materializing it. JamiaMilliaIslamia is committed to the systemic reform and continuous improvement in the quality of its teaching-learning-research process; we welcome comments and suggestions which enable us to understand further refinement and enhancement of the syllabi according to the need of current scenario.

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ABOUT JAMIA MILLIA ISLAMIA

Introduction:

JamiaMilliaIslamia, an institution originally established at Aligarh in United Provinces, India in 1920 became a Central University by an act of the Indian Parliament in 1988. In Urdu language, Jamia means 'University', and Millia means 'National'. The story of its growth from a small institution in the pre-independence India to a central university located in New Delhi—offering integrated education from nursery to research in specialized areas—is a saga of dedication, conviction and vision of a people who worked against all odds and saw it growing step by step. They "built up the JamiaMillia stone by stone and sacrifice by sacrifice," said Sarojini Naidu, the nightingale of India.

Conception:

Under the colonial British rule, two dominant trends joined hands and contributed towards in the birth of Jamia. One was the anti-colonial Islamic activism and the other was the pro-independence aspiration of the politically radical section of western educated Indian Muslim intelligentsia. In the political climate of 1920, the two trends gravitated together with Mahatma Gandhi as a catalyst. The anti-colonial activism signified by the Khilafat and the pro-independence aspirations symbolized by the non-cooperation movement of the Indian National Congress helped to harness creative energies and the subsequent making of JamiaMilliaIslamia. Rabindranath Tagore called it "one of the most progressive educational institutions of India". Responding to Gandhiji's call to boycott all educational institutions supported or run by the colonial regime, a group of nationalist teachers and students quit Aligarh Muslim University, protesting against its pro-British inclinations. The prominent members of this movement were MaulanaMehmudHasan, Maulana Mohamed Ali, Hakim Ajmal Khan, Dr. Mukhtar Ahmad Ansari, and Abdul Majid Khwaja.

Foundation:

The Foundation Committee met on 29 October 1920. It comprised of the following members:
Dr. Mukhtar Ahmad Ansari (Delhi) Mufti Kafayattullah (Delhi)
Maulana Abdul Bari Farang Mahali (UP) Maulana Sulaiman Nadvi (Bihar)
Maulana Shabbir Ahmed Usmani (UP) Maulana Husain Ahmad Madni (UP)
Chaudhury Khaleeq-uz-zaman (UP) Nawab Mohammad Ismail Khan
Tasadduq Husain Khan (UP) Dr. Mohammad Iqbal (Punjab)
Maulana Sanaullah Khan Amritsari (Punjab) Dr. Saifuddin Kitchlew (Punjab)
Maulana Abul Kalam Azad (Bengal and Bihar) Dr. Syed Mehmood (Bengal & Bihar)
Saith Abdullah Haroon Karachiwale (Sindh, Bombay and Hyderabad)
Sait Miyan Mohammad Haji Jaam Chhotani (Sindh, Bombay and Hyderabad)
Maulavi Abdul Haq (Sindh, Bombay & Hyderabad)
Abbas Tyabiji (Sindh, Bombay & Hyderabad)

On 22 November 1920, Hakim Ajmal Khan was elected the first chancellor of Jamia. Mohamed Ali Jauhar became Jamia's first Vice Chancellor, as Allama Iqbal could not accept the offer made through Gandhiji. It also elected a syndicate and created a syllabus subcommittee. The known freedom fighter and Muslim theologian, Maulana Mehmud Hasan, laid the foundation stone of JamiaMilliaIslamia at Aligarh on Friday, 29 October 1920. Considering the difficult circumstances under which it started, the list of its first teachers is very impressive:

Crisis:

Born out of political crisis, it seemed for a while; Jamia would not survive the heat of the intense political struggle for the independence of India. It participated in the Bardoli resolution and sent volunteers across the country to motivate people to fight for the freedom of the country. The colonial British government soon imprisoned many of its teachers and students. In 1922, Gandhiji called off the non-cooperation movement. Even as its teachers and students were being released, Mustapha Kemal Ataturk declared the end of the Khilafat in 1924. Suddenly Jamia saw itself in a great crisis. Some thought it had achieved its mission, as others believed that the institution had lost its raison d'etre with the end of the noncooperation and the Khilafat movements. Even the little financial assistance, that the Khilafat had been giving it, also dried up. As even prominent people started deserting it, Jamia's total collapse virtually became an imminent possibility.

Jamia Moves to Delhi:

The saying, 'when going gets tough the tough gets going' cannot be truer about Jamia. As the crisis loomed large, Hakim Ajmal Khan, Dr. Mukhtar Ahmed Ansari and Abdul MajeedKhwaja—the first trio—supported by Gandhiji shifted Jamia from Aligarh to Karol Bagh, in New Delhi in 1925. Gandhiji boosted the morale of Jamia, saying, "The Jamia has to run. If you are worried about its finances, I will go about with a begging bowl". Jamia followed Gandhiji's constructive programme for self-reliance while it took to Charkha and Takli as favoured vocations.

Although Gandhi's contacts helped to secure financial help for Jamia, the risk of helping a Congress-backed institution under the British Raj dissuaded many willing benefactors. Orthodox Muslims also viewed Jamia as a threat to Aligarh Muslim University, the 'Muslim Oxford'. During those difficult days, it was Hakim Ajmal Khan who met most of Jamia's expenses from his own pocket. Dr. M.A. Ansari and Abdul MajeedKhwaja toured India and abroad, explaining the importance of Jamia and collecting funds for this noble enterprise. Their collective intervention did avert a collapse that was almost certain.

Resurgence: The Second Trio:

In 1925, after long deliberation, a group of three friends studying in Germany—Dr. Zakir Husain, Dr. Abid Husain and Dr. Mohammad Mujeeb— decided to serve Jamia. Dr. Zakir Husain, who had earned his doctorate in Economics from the University of Berlin, was a natural and charismatic leader. Dr. Abid Husain had his Ph.D. in Education. Mohammad Mujeeb, an Oxford scholar in History and a student of printing in Germany, was a passionate and Committee

dreformist. Early in February 1926, the three friends left Germany for Jamia by the Norddeutscher Lloyd steamer, SS Derfflinger.

In Jamia, Dr. Zakir Husain, was offered a salary of Rs. 100. His two other friends with European qualifications were offered Rs 300 each. Realising that the possibility of making payments was beyond Jamia's limited resources, Abid Husain and Mohammad Mujeeb voluntarily reduced their salaries to Rs. 100 each. Moved by the commitment of his friends, Dr. Zakir Husain also reduced his own salary to Rs. 80. One of the first steps they took was the introduction of the hugely popular evening classes for adult education. This movement was later to become, in October 1938, an institution called Idara-i-Taleem-o-Taraqqi. It kept growing so popular that separate rooms had to be built to accommodate the students.

In 1928 Hakim Ajmal Khan passed away. That was the beginning of the second financial crisis, as it was Hakim Sahib himself who had been meeting most of Jamia's financial needs. The leadership of Jamia then moved into the hands of Dr. Zakir Husain, who became its Vice Chancellor in 1928. To resolve Jamia of these frequent crises, a group of young Jamia teachers, led by Dr. Zakir Husain, took a pledge to serve Jamia for the next twenty years on a salary not more than Rs. 150. This group was called the Life Members of Jamia. (History repeated in 1942 when a second group of Jamia teachers took a similar pledge)Jamia's department of Printing and Publications was trifurcated in 1928 with the newly established Jamia Press at Daryaganj, Urdu Academy, and MaktabaJamia under the charge of Prof. Mohammad Mujeeb, Dr. Abid Husain and Mr. Hamid Ali respectively.

Shifting to the New Campus:

On 1 March 1935, the foundation stone for a school building was laid at Okhla, then a non-descript village in the southern outskirts of Delhi.

In 1936, all institutions of Jamia, except Jamia Press, the Maktaba and the library, were shifted to the new campus. The basic emphasis of Jamia was on evolving innovative education methods. This led to the establishment of a teacher's college (Ustadonka Madrasa) in 1938. In 1936, Dr. M.A. Ansari passed away. On 4 June 1939, JamiaMilliaIslamia was registered as a society. The fame of Jamia as an innovative education movement spread and dignitaries from foreign countries began visiting Jamia. Husein Raouf Bey (1933), Dr. Behadjet Wahbi of Cairo (1934), Ms. Halide Edib of Turkey (1936) were some of them. Foreigners, impressed by Jamia, began working in Jamia. The German lady Ms. Gerda Philipsborn (popularly known as AapaJaan) served Jamia for many years is buried in Jamia. In 1939, Maulana Ubaidullah Sindhi (1872-1944), a theologian and freedom fighter, came to stay in Jamia on the invitation of Dr. Zakir Husain. He started a school of Islamic Studies in Jamia, called Baitul Hikmal, propagating the ideology of Shah Waliullah. Zakir Husain, later the President of India, recalled those days of indestructible optimism in the face of depravity 'when they had a longing to build and nothing to build with, as "days of joy". In 1946, during Jamia's silver jubilee celebration, one could see the crisis that India had to face in the following year: Mr. and Mrs. Mohammad Ali Jinnah, and Liyagat Ali Khan were on one side of Dr. Zakir Husain, the vice chancellor, on the dias; Pandit Jawaharlal Nehru, Asaf Ali and Sir C Rajagolapachari were on the other side.

Independence and After:

The riots following partition that shook the northern India did affect Jamia; but not its campus. Gandhi observed that its campus remained "an oasis of peace in the Sahara" of communal violence. Maktaba Jamia alone lost books worth seven lakhs in arson.
After the attainment of Independence, Jamia continued to grow as an academic institution with a difference. Many foreign dignitaries made it a point to visit Jamia Millia Islamia during their visits to New Delhi. Among those who visited Jamia include Marshal Tito (1954), king Zahir Shah of Afghanistan (1955), crown prince Faisal of Saudi Arabia, King Reza Shah Pehlavi of Iran (1956) and prince Mukarram Jah (1960). Following the death of Mr. Abdul Majeed Khwaja in 1962, Dr. Zakir. Husain, who by then had taken charge as the Vice President of India, became Jamia's Chancellor (1963).

Deemed to be University:

In 1962, the University Grants Commission declared the Jamia a 'deemed to be University'. Soon thereafter, the School of Social Work was established in 1967. In 1971, Jamia started the Zakir Husain Institute of Islamic Studies, to honour Dr. Zakir Husain, who had passed away in 1969. BE course in Civil Engineering commenced in 1978; in 1981, the faculties of Humanities and Languages, Natural Sciences, Social Science, and the State Resource Centre were founded. In 1983, it started the Mass Communication Research Centre and the Centre for Coaching and Career Planning. In 1985, it established the Faculty of Engineering & Technology and the University Computer Centre. Academic Staff College and the Academy of Third World Studies followed in 1987 and 1988.

Central University:

By a Special Act of the Parliament, Jamia Millia Islamia was made a central university of India in December 1988. In the list of the faculties i.e. Education, Humanities & Languages, Natural Sciences, Social Sciences. Engineering & Technology, one more Faculty - Faculty of Law, was added in 1989. Many new courses and programmes at UG and PG levels have since been added. Besides its nine faculties, the Jamia has a number of centres of learning and research, like AJK-Mass Communication Research Centre (MCRC), Academy of International Studies etc. The Jamia is also marching ahead in the field of Information Technology (IT). It offers various undergraduate and postgraduate IT courses. Apart from this, the Jamia has a campus wide network which connects a large number of its departments and offices.

Department of Mechanical Engineering: A Brief Overview

The Faculty of Engineering and Technology at the Jamia Millia Islamia, New Delhi is a leading and dynamic institution. This Faculty is one of the foremost providers of high-level technical education and research in the University; it is renowned for its unique approach to innovations, status and its links with the industry and academia.

This Department provides students with a sound mechanical engineering education, enhance the understanding and application of mechanical engineering principles for techno- economical development of the country, and improve the quality of life of citizens through teaching, research, and outreach programs. The mission is further to provide an environment where students have extensive avenues to excel, improve technical exposure, develop personality and then get placed in reputed companies, PSUs, MNCs, go for higher studies and undertake entrepreneurship. Our students have global presence, in various roles and responsibilities. With excellent teaching and learning environment it provides a platform to install high motivation, moral values and leadership in its students.

The Department offers eight-semester Bachelor of Technology (B. Tech.) program with an annual intake of seventy, four-semester Master of Technology (M. Tech.) course with annual intake of eighteen (six each in three streams) and Doctor of Philosophy (Ph.D.) in Mechanical Engineering. M. Tech. Program is offered in three broad areas of Mechanical Engineering namely, Production-Industrial Engineering, Machine Design and Thermal Engineering. In addition, it also offers four-year, Bachelor of Engineering (B.E) (Part-Time) program in the evening with an annual intake of seventy for working diploma holders to up-grade their knowledge and skill.

The students are from diverse background and are selected through a nationwide written test. The posh campus, situated in southern suburb of national capital provides excellent teaching and learning environment to the students. Classrooms are fitted with modern audio-visual aids and even few are smart classrooms. The undergraduate curriculum of the Department includes a foundation of mathematics, physics, chemistry, environment, social science, organization behavior, humanities, and basic engineering subjects. Engineering courses in fundamental areas constitute much of the remaining curriculum. A few technical electives allow the undergraduate student to specialize somewhat or to pursue broader understanding. In addition, the students develop experiment conducting skill by performing experiments in 20 different laboratories in the department. Department also supports workshop Engineering drawing thermodynamics and mechanics to students of all branches of Engineering at first year level.

Department's strength is good teaching and research; it has a sanctioned strength of 28 teaching and 22 technical staff. It has active and vibrant students' chapters of major professional bodies as American Society of Mechanical Engineers (ASME), and Society of Automotive Engineers

(SAE). Here they get a world class platform for organizing, participating and developing engineering ideas. This helps them in developing a holistic personality. SAEDepartment's commitment to quality education India and one of the foremost providers of high-level intellectual capital. Its staff, Support facilities that include sophisticated experimental and assisted computer laboratories. Department facilities includes the unique laboratories for Computer Integrated Manufacturing, Micro measurement, Ergonomics, Solar energy, Instrumentation & control, Refrigeration & Air Conditioning, etc. which are important for mechanical engineering education The Department derives its excellence from the team of highly qualified, experienced, sincere and dedicated teaching faculty members, all employed have PhDs, except few members pursuing research. The Faculty members actively participate in research and consultancy-work with a gross departmental publication of exceeding 600 in reputed refereed International Journals.

Research in the Department of Mechanical Engineering is diverse, and scholars are directly exposed to the multidisciplinary nature of modern mechanical engineering and its allied areas. At any point of time approximate 40 students are enrolled in the department for research. The Department provides facilities and supervision to conduct research on advanced topics like materials, friction stir welding, supply chain, Innovation, renewable energy, solar energy, green practices, ergonomics, micro-channel, fluid dynamics, product design, kinematics, machine design etc.

The Department has active collaboration with academics and industry such as University of Salford (UK), CH, HT Delhi, AMU, NTPC, TERI, DTU, DST, DRDO, currently department is undertaking three sponsored research projects one from Department of Science and Technology for Rs 16.36 lac (on Technology Forecasting and Assessment) and another from Ministry of Environment and Forests partnered with TERI for Rs 68 lac and third from UGC-SAP of Rs. 32 in the area of friction stir welding and ultrasonic machining. Department is FIST supported and has received funding of Rs.132 lac in product design. It also has UGC-DRS/ 0 lac as well as AICTE grants of 15 lac & 19.75 lacs.

In the past, several events including International conferences, National conferences, Summer schools, Seminars and Workshops related to various areas of Mechanical Engineering have been organized and similar events are planned to be organized in future too.

Bachelor of Technology (Mechanical Engineering) in Semester System and the Academic Calendar

Bachelor of Technology (Mechanical Engineering), programme at the Department is offered under semester system. A full academic year consists of two semesters. Total program is of four years duration consisting of eight semesters. During this program these students are required to observe the university regulations. This is a 263-credit program involving a total of 50 papers out of which 33 are taught by the department teachers. Good experimentation and research focus is provided to this program by 36 laboratory courses, seminar, tutorials and projects. The course curriculum has been designed to prepare its graduates to become intellectual leaders in industry, government, and academia. Graduates of this program will have the professional and scientific knowledge that allows them to be successful as career engineers and in the most demanding graduate programs. Specifically, they will be able to:

- Function in professional environments in industry, government, and academia applying and building upon engineering science knowledge, problem-solving skills, and communication skills;
- Function as members of teams and in leadership roles applying ethical standards beyond traditional Mechanical engineering disciplines; Remain acquainted with technology and contemporary scientific and societal issues, and consequently improve skills and knowledge through a lifelong process of learning

B. Tech in Mechanical Engineering is being offered with specific focus on best quality academic learning and with extensive laboratory support. The department is producing generic engineers who can and have the capability to take leading positions in industry, academics, research & consultancy and allied jobs. The input to this program is through an all India competitive examination and large number of students applied for few seats.

Students are exposed to the world class learning environment and are put through the rigour of this program. Courses are developed and offered looking into the future and contemporary Indian requirements. The core competence of the department for this program is to generate and transfer knowledge and build academic excellence. Delhi is the national capital of India and the University is well located between many industrial hubs and office complexes. It has proximity to nearby industry. Students get extensive exposure from these industries and research & development centers and also, they have excellent job opportunities.

PROJECT/ RESEARCH BASED LEARNING

Students are expected to engage in innovative project/research work during their study for the credits prescribed under their curriculum. Through the project/ research work, students are expected to demonstrate that the programme learning outcomes are being met and they have the

ability to solve problems using the knowledge gained in the courses. The project/ research work may be based on theoretical analysis, modelling and simulation, experimentation and analysis, prototype design, fabrication of new equipment, correlation and analysis of data, etc. or a combination of these.

Depending on the nature of the research or project, students could be engaged as individuals or as a part of a project team. Each student/ team will be assigned a faculty member as guide. In some instances, with the permission of Head, the student may opt for a guide outside their Department. In the case of projects conducted outside the department, there must be an external co-guide who is an employee of the company/ organization in addition to the one from the department. In case of group projects, the individual project report prepared by each student in the group will have different project titles to highlight the individual's contribution to the group project. The students must submit their original work only. Use of plagiarized or copied work is strictly prohibited and will result in a failing grade and the student will be required to repeat the entire subject. Students are expected to decide on the specific project/ research area and title, and carry out substantial portion of the literature survey. A mid semester presentation will be required.

VISION and MISSION of the Department of Mechanical Engineering ,Faculty of Engineering &Technology

Jamia Millia Islamia ,New Delhi 110025

Vision:

To Establish the Department as a hub of quality education, research with innovation and recognition at National and International level.

Mission:

1. To transfer the knowledge through quality education which can develop skills, inculcate values and improve research with innovative methods.
2. To re-engineer the engineering education and to create leadership qualities with futuristic vision.
3. To produce young engineers who can be useful in New Technological Design, areas of Environment, space and sustainable technologies.
4. To develop Teaching-Learning methods which can produce socially committed good professional human being who can contribute effectively in Nation building and represent Country Internationally.

Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

The Department of Mechanical Engineering in consultation with various stakeholders have formulated the Programme Educational Objectives (PEO's) that are broad statements that describe the career and professional accomplishments that the program is preparing its graduates to achieve in few years, subsequent to receiving the degree. The PEO's of the B. Tech. programme in Mechanical Engineering are as follows:

Program Educational Objectives (PEOs)

1. The graduates will be well prepared for successful careers in industry/ consultancy/research & development/teaching/allied areas and will be academically prepared to lead organizations they join or start related to the subjects of mechanical engineering.
2. The graduates will engage in professional and extension activities in the field of mechanical engineering and its allied areas and contribute to the profession and society at large by pushing the frontiers in technology.
3. The graduates will be successful in higher education in mechanical and allied areas and in management, if pursued, leading to masters and research programs
4. The graduates will be, through this academic programme groomed as professional engineers enabling them to contribute effectively to the growth and development of the knowledge body.

Programme Outcomes are attributes of the graduates from the programme that are indicative of the graduates' ability and competence to work as an engineering professional upon graduation. Program Outcomes are statements that describe what students are expected to know or do by the time of graduation, they must relate to knowledge and skills that the students acquire from the programme. The achievement of all outcomes indicates that the student is well prepared to achieve the program educational objectives down the road. The department of Mechanical engineering has following twelve PO's. The course syllabi and the overall curriculum are designed to achieve these outcomes:

Programme Outcomes (POs)

1. **Engineering Knowledge:** Apply the knowledge of Mathematics, Science and Engineering Fundamentals, and an engineering specialization to solution of complex engineering problems.
2. **Problem formulation and Analysis:** Identify, formulate, research literature, and analyze engineering problems so that substantiated conclusions can be reached using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/ development of solutions:** Design of solution for engineering problems and identify/design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations.
4. **Conduct investigation of Complex problems:** Use of research based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling related engineering activities with an understanding of limitations.
6. **Engineer and Society**: Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and assume responsibilities of a professional engineering practitioner.
7. **Environment awareness and responsibility:** Understanding the impact of the professional engineering solutions in the environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.
8. **Ethical behavior:** Apply ethical principle and show commitment towards professional ethics and responsibilities and norms of engineering practice.
9. **Individual and team work:** Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on different engineering activities with the engineering community and with society at large such as being able to comprehend and write effective report and design documentation, make effective oral presentations, and give and receive clear instructions.
11. **Project Management and Finance:-**Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments.
12. **Life- long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of new development. Can take masters and research program in the area and allied areas.

Program Specific Outcomes (PSOs)

PSO1: Shall have acquired the ability of entrepreneurship to start an industry based on mechanical engineering in the areas of production, manufacturing and allied areas.

PSO2: After graduation the graduate shall have gained the experience to be attracted toward design and consultancy.

PSO3: Shall have gained the knowledge to pursue higher level of understanding by way of research in relevant areas of mechanical engineering.

PSO4: Shall have gained the knowledge base to enable employment in infrastructure development.

Choice Based Credit System COURSE STRUCTUREsection wise B. Tech. (I & II Semesters)

COURSE NAME : B. TECH.
SEMESTER : FIRST (I)

SECTION A

S. No.	PapertypeCBCS/CORE/AECC/SEC Etc.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-104	Engineering Mathematics – I	04	40	60
2.	CORE	AS-102	Engineering Physics – I	03	30	45
3.	CORE	AS-103	Engineering Chemistry – I	03	30	45
4.	AECC	AS-101	Communication Skills	03	30	45
5.	CORE	EC-101	Basics of Electronics Engineering	03	30	45
6.	CORE	CE-101	Basics of Civil & Environmental Engineering	03	30	45
7.	CBCS	AS-105	Innovative Science & Technology	03	30	45
8.	**Laboratories**	AS -152	Engineering Physics LAB – I	01	15	10
9.		AS -153	Engineering Chemistry LAB – I	01	15	10
10.		AS-151	Language Lab	01	15	10
11.		ME-151	Workshop Practice	02	30	20

SECTION B

S. No.	PAPER TYPE CBCS/CORE/ AECC/SEC ETC.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-104	Engineering Mathematics – I	04	40	60
2.	CORE	AS-102	Engineering Physics – I	03	30	45
3.	CORE	AS-103	Engineering Chemistry – I	03	30	45
4.	AECC	AS-101	Communication Skills	03	30	45
5.	CORE	EC-101	Basics of Electronics Engineering	03	30	45
6.	CORE	CE-101	Basics of Civil & Environmental Engineering	03	30	45
7.	CBCS	AS-105	Innovative Science & Technology	03	30	45
8.	**Laboratories**	AS -152	Engineering Physics LAB – I	01	15	10
9.		AS -153	Engineering Chemistry LAB – I	01	15	10
10.		AS-151	Language Lab	01	15	10
11.		ME-151	Workshop Practice	02	30	20

SECTION C

S. No.	PAPER TYPE CBCS/CORE/ AECC/SEC ETC.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-104	Engineering Mathematics – I	04	40	60
2.	CORE	AS-102	Engineering Physics – I	03	30	45
3.	CORE	AS-103	Engineering Chemistry – I	03	30	45
4.	SEC	AS-201	Human Resource Management	03	30	45
5.	CORE	EE-101	Basics of Electrical Engineering	01	30	45
6.	CORE	ME-101	Basics of Mechanical Engineering	03	30	45
7.	CORE	FC-101	Fundamentals of Computing	03	30	45
8.	**Laboratories**	AS -152	Engineering Physics LAB – I	01	15	10
9.		AS -153	Engineering Chemistry LAB – I	01	15	10
10.		ME-151	Workshop Practice	02	30	20
11.		ME-102	Engineering Mechanics Lab	01	15	10

SECTION D

S. No.	PAPER TYPE CBCS/CORE/ AECC/SEC ETC.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-104	Engineering Mathematics - I	04	40	60
2.	CORE	AS-102	Engineering Physics – I	03	30	45
3.	CORE	AS-103	Engineering Chemistry – I	03	30	45
4.	SEC	AS-201	Human Resource Management	03	30	45
5.	CORE	EE-101	Basics of Electrical Engineering	01	30	45
6.	CORE	ME-101	Basics of Mechanical Engineering	03	30	45
7.	CORE	FC-101	Fundamentals of Computing	03	30	45
8.	**Laboratories**	AS – 152	Engineering Physics LAB – I	01	15	10
9.		AS – 153	Engineering Chemistry LAB – I	01	15	10
10.		ME-250	Engineering Graphics	02	30	20
11.		ME-102	Engineering Mechanics Lab	01	15	10

SECTION E

S. No.	PAPER TYPE CBCS/CORE/ AECC/SEC ETC.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-104	Engineering Mathematics - I	04	40	60
2.	CORE	AS-102	Engineering Physics – I	03	30	45
3.	CORE	AS-103	Engineering Chemistry – I	03	30	45
4.	SEC	AS-201	Human Resource Management	03	30	45
5.	CORE	EE-101	Basics of Electrical Engineering	01	30	45
6.	CORE	ME-101	Basics of Mechanical Engineering	03	30	45
7.	CORE	FC-101	Fundamentals of Computing	03	30	45
8.	**Laboratories**	AS – 152	Engineering Physics LAB – I	01	15	10
9.		AS – 153	Engineering Chemistry LAB – I	01	15	10
10.		ME-250	Engineering Graphics	02	30	20
11.		ME-102	Engineering Mechanics Lab	01	15	10

COURSE NAME : B. TECH.
SEMESTER : SECOND (II)

SECTION A

S. No.	PapertypeCBCS/CORE/AECC/SEC Etc.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-204	Engineering Mathematics - II	04	40	60
2.	CORE	AS-202	Engineering Physics – II	03	30	45
3.	CORE	AS-203	Engineering Chemistry – II	03	30	45
4.	SEC	AS-201	Human Resource Management	03	30	45
5.	CORE	EE-101	Basics of Electrical Engineering	03	30	45
6.	CORE	ME-101	Basics of Mechanical Engineering	03	30	45
7.	CORE	FC-101	Fundamentals of Computing	03	30	45
8.	**Laboratories**	AS - 252	Engineering Physics LAB – II	01	15	10
9.		AS - 253	Engineering Chemistry LAB – II	01	15	10
10.		ME-250	Engineering Graphics	02	30	20
11.		ME-102	Engineering Mechanics Lab	01	15	10

SECTION B

S. No.	PAPER TYPE CBCS/CORE/ AECC/SEC ETC.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-204	Engineering Mathematics - II	04	40	60
2.	CORE	AS-202	Engineering Physics – II	03	30	45
3.	CORE	AS-203	Engineering Chemistry – II	03	30	45
4.	SEC	AS-201	Human Resource Management	03	30	45
5.	CORE	EE-101	Basics of Electrical Engineering	03	30	45
6.	CORE	ME-101	Basics of Mechanical Engineering	03	30	45
7.	CORE	CS-101	Fundamentals of Computing	03	30	45
8.	**Laboratories**	AS-252	Engineering Physics LAB – II	01	15	10
9.		AS-253	Engineering Chemistry LAB – II	01	15	10
10.		ME-250	Engineering Graphics	02	30	20
11.		ME-102	Engineering Mechanics Lab	01	15	10

SECTION C

S. No.	PAPER TYPE CBCS/CORE/ AECC/SEC ETC.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-204	Engineering Mathematics - II	04	40	60
2.	CORE	AS-202	Engineering Physics – II	03	30	45
3.	CORE	AS-203	Engineering Chemistry – II	03	30	45
4.	AECC	AS-101	Communication Skills	03	30	45
5.	CORE	EC-101	Basics of Electronics Engineering	03	30	45
6.	CORE	CE-101	Basics of Civil & Environmental Engineering	03	30	45
7.	CBCS	AS - 205	Innovative Science & Technology	03	30	45
8.	**Laboratories**	AS - 252	Engineering Physics LAB – II	01	15	10
9.		AS - 253	Engineering Chemistry LAB – II	01	15	10
10.		AS - 151	Language Lab	01	15	10
11.		ME-250	Engineering Graphics	02	30	20

SECTION D

S. No.	PAPER TYPE CBCS/CORE/ AECC/SEC ETC.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-204	Engineering Mathematics - II	04	40	60
2.	CORE	AS-202	Engineering Physics – II	03	30	45

3.	CORE	AS-203	Engineering Chemistry – II	03	30	45
4.	AECC	AS-101	Communication Skills	03	30	45
5.	CORE	EC-101	Basics of Electronics Engineering	03	30	45
6.	CORE	CE-101	Basics of Civil & Environmental Engineering	03	30	45
7.	CBCS	AS-105	Innovative Science & Technology	03	30	45
8.	**Laboratories**	AS -252	Engineering Physics LAB – I	01	15	10
9.		AS -253	Engineering Chemistry LAB – I	01	15	10
10.		AS-151	Language Lab	01	15	10
11.		ME-151	Workshop Practice	02	30	20

SECTION E

S. No.	PAPER TYPE CBCS/CORE/ AECC/SEC ETC.	PAPER CODE	TITLE OF PAPER	CREDIT	SESSIONAL	END-TERM
1.	CORE	AS-204	Engineering Mathematics – II	04	40	60
2.	CORE	AS-202	Engineering Physics – II	03	30	45
3.	CORE	AS-203	Engineering Chemistry – II	03	30	45
4.	AECC	AS-101	Communication Skills	03	30	45
5.	CORE	EC-101	Basics of Electronics Engineering	03	30	45
6.	CORE	CE-101	Basics of Civil & Environmental Engineering	03	30	45
7.	CBCS	AS-105	Innovative Science & Technology	03	30	45
8.	**Laboratories**	AS -252	Engineering Physics LAB – II	01	15	10
9.		AS -253	Engineering Chemistry LAB – II	01	15	10
10.		AS-151	Language Lab	01	15	10
11.		ME-151	Workshop Practice	02	30	20

Choice Based Credit System COURSE STRUCTURE B. Tech. Mechanical Engineering (III to VIII semester)

Semester	Core Subjects	CBCS	SEC	AECC	Total Paper	Credits
III	**Theory Courses** BM-30 Mechanics of Solid BM -302Manufacturing Processes BM-303Applied Thermodynamics	BM-304 Material Science	BM-305 Mechatronics		3+1+1=5	20
	Lab Courses BM-351Applied Thermodynamics BM-352Mechanics of Solids and Mechatronics BM-353Materials and Manufacturing Processes				3	6
					Total	**26**
IV	**Theory Courses** BM-401 Heat and Mass Transfer BM-402 Fluid MechanicsI BM-403 Production Engineering-I	BM-404 CAD & FEM	BM-405 Instrumentation, Measurementand control.	BM-406 Numeric and Scientific Computing	3+1+1+1=6	24
	Lab Courses BM-451Heat and Mass Transfer Instrumentation, Measurement and control. BM-452 Production Engineering BM-453 Computer Aided Machine Design BM-454Industrial Training (six week) in summer (Audit Course with no credit)				3	6
					Total	**30**
V	**Theory Courses** BM-501Kinematics of Machines BM-502Fluid Mechanics II BM-503Design of Mechanical components	BM-504 Engineering Economy	BM-505 ElectromechanicalEnergy Conversion		3+1+1=5	20
	Lab Courses BM-551 Fluid Mechanics Lab BM-552Design of Mechanical Components Practice BM-553Mechanisms and Kinematics of Machines				3	6
					Total	**26**

VI	**Theory Courses** BM-601Computer Aided Manufacturing BM-602 Design of Mechanical System **Lab Courses** BM-651 Computer Aided Manufacturing BM-652 Refrigeration and Air Conditioning BM-653Design of Mechanical Systems Practice BM-654 Industrial Training (six week) in summer (Audit Course with no credit)	BM-603 Operations Research	BM-604 Refrigeration and Air conditioning	BM-605 IC Engines	2+1+1+1=5 3 **Total**	20 6 **26**
VII	**Theory Courses** BM-701Dynamics of Machines and mechanical vibrations BM-702 Production Engineering-II **Lab Courses** BM-751Dynamics of Machines and mechanical vibrations BM-752 Industrial Engineering Turbo machines and solar energy lab BM-753Minor Project (2 Credits)	BM-703 Turbo Machine	BM-704 Energy Sources	BM-705 Industrial Engineering	2+1+1+1=5 3 **Total**	20 8 **28**
VIII	**Theory Courses** BM-801 Product Design **Lab Courses** BM-851 IC Engine and Automobile Engineering lab BM-852 Seminar on Industrial Training BM-853 Project (4-Credits)	BM-802 Robotics	BM-803 Automobile Engineering	BM-804 Ergonomics	1+1+1+1=4 3 **Total**	16 8 **24**
No. of Theory Papers	14	6	6	4	**30**	
Total Credits Theory Paper	4 x 14 = 56	4 x 6 = 24	4 x 6 =24	4 x 4 = 16		**120**
Total Credits Lab						**40**
Total credits theory and lab						**160**

NOTE:

1. Each theory course will be of 4 credits and each lab course will be of 2 credits except project.
2. For CBCS courses maximum 5 seats are available for the students of other department and will be offered on the basis of first come first served.

Choice Based Credit System COURSE STRUCTURE Semester wise B. Tech. (I & II semesters)

(All Branches/ Sections)

I - Semester

Course Code	Course Title	Credits	Periods per week			Marks			Remarks
			L	T	P	Sessional	Theory	Practical	
AS-101	Communication skill	3	3	..	..	30	45		AECC
AS-151	Language Lab	1	..	..	2	15	..	10	AECC
AS-102	Engineering Physics-1	3	2	1	..	30	45		Core
AS-152	Engineering Physics Lab-1	1	..	..	2.	15	…	10	Core
AS-103	Engineering Chemistry-1	3	2	1	..	30	45	10	Core
AS-153	Engineering Chemistry Lab-1	1	…	..	2	15	..		Core
AS-104	Engineering Mathematics-1	4	3	1	..	40	60		Core
ME-101	Basics of Mechanical Engineering	3	2	1	..	30	45		Core
CE-101	Basics of Civil & Environmental Engineering	3	2	1	..	30	45		Core
ME-151	Workshop Practice	2	..	..	4	30	…	20	Core
	Total	**24**	**14**	**5**	**10**	**265**	**285**	**50**	
	Total Hrs.				**29**		**600**		

II- Semester

Course Code	Course Title	Credits	Periods per week			Marks			Remarks
			L	T	P	Sessional	Theory	Practical	
AS-201	Human Resource Management	3	2	1	..	30	45		SEC
AS-202	Engineering Physics-II	3	2	1	..	30	45		Core
AS-252	Engineering Physics Lab-II	1	..	..	2	15	…	10	Core
AS-203	Engineering Chemistry-1	3	2	1	..	30	45		Core
AS-253	Engineering Chemistry Lab-1	1	..	..	2	15	..	10	Core
AS-204	Engineering Mathematics-II	4	3	1	..	40	60		Core
AS-205	Innovative Science & Technology	3	2	1	..	30	45		Core
EE-101	Basic Electrical Engineering	3	2	1	..	30	45		Core
EC-101	Basics Electronic & communication	3	2	1	..	20	45		Core
CS-101	Fundamental of Computing	3	2	..	..	30	45		Core
ME-250	Engineering Graphics	2	..	..	4	30	..	20	Core
	Total	**29**	**17**	**7**	**8**	**310**	**375**	**40**	
	Total Hrs.				**32**		**725**		

Choice Based Credit System COURSE STRUCTURE Description B. Tech. Mechanical Engineering (III to VIII semester)

III - Semester

Course Type	Course Code	Course Title	End Semester Examination (Theory/Practical)	Sessional	Credits
Theory	BM - 301	Mechanics of Solid	60	40	4
	BM - 302	Manufacturing Processes	60	40	4
	BM - 303	Applied Thermodynamics	60	40	4
	BM - 304	Material Science	60	40	4
	BM - 305	Mechatronics	60	40	4
		Total Credit			**20**
Labora-tory	BM- 351	Applied Thermodynamics	20	30	2
	BM - 352	Mechanics of Solids and Mechatronics	20	30	2
	BM - 353	Material Science and Manufacturing Processes	20	30	2
		Total Credit			**6**
		Total Marks = 650;	**Total Credits= 26**		

IV - Semester

Course Type	Course Code	Course Title	End Semester Examination (Theory/Practical)	Sessional	Credits
Theory	BM - 401	Heat and Mass Transfer	60	40	4
	BM - 402	Fluid Mechanics - I	60	40	4
	BM - 403	Production Engineering- I	60	40	4
	BM - 404	CAD & FEM	60	40	4
	BM - 405	Instrumentation, Measurement and Control	60	40	4
	BM - 406	Numeric and Scientific Computing	60	40	4
		Total Credit			**24**
Labora -tory	BM- 451	Heat and Mass Transfer Instrumentation, Measurement and Control	20	30	2
	BM - 452	Production Engineering	20	30	2
	BM - 453	Computer Aided Machine Design	20	30	2
	BM - 454	Industrial Training (Six week) in summer (Audit course with no credit)			
		Total Credit			**6**
		Total Marks = 750;	**Total Credits= 30**		

V - Semester

Course Type	Course Code	Course Title	End Semester Examination (Theory/Practical)	Sessional	Credits
Theory	BM - 501	Kinematics of Machines	60	40	4
	BM - 502	Fluid Mechanics II	60	40	4
	BM - 503	Design of Mechanical Components	60	40	4
	BM - 504	Engineering Economy	60	40	4
	BM - 505	Electromechanical Energy Conversion	60	40	4
		Total Credit			**20**
Labora-tory	BM - 551	Fluid Mechanics Lab	20	30	2
	BM - 552	Design of Mechanical Components Practice	20	30	2
	BM - 553	Mechanism and Kinematics of Machines	20	30	2
		Total Credit			**6**
		Total Marks = 650;	**Total Credits = 26**		

VI - Semester

Course Type	Course Code	Course Title	End Semester Examination (Theory/Practical)	Sessional	Credits
Theory	BM - 601	Computer Aided Manufacturing	60	40	4
	BM - 602	Design of Mechanical System	60	40	4
	BM - 603	Operations Research	60	40	4
	BM - 604	Refrigeration and Air-Conditioning	60	40	4
	BM - 605	IC Engines	60	40	4
		Total Credit			**20**
Labora-tory	BM – 651	Computer Aided Manufacturing	20	30	2
	BM - 652	Refrigeration and Air-Conditioning	20	30	2
	BM - 653	Design of Mechanical System Practice	20	30	2
	BM - 654	Industrial Training (Six week) in summer (Audit course with no credit)			
		Total Credit			**6**
		Total Marks = 650;	**Total Credits = 26**		

VII - Semester

Course Type	Course Code	Course Title	End Semester Examination (Theory/Practical)	Sessional	Credits
Theory	BM - 701	Dynamics of Machines and Mechanical Vibrations	60	40	4
	BM - 702	Production Engineering- II	60	40	4
	BM - 703	Turbo Machine	60	40	4
	BM - 704	Energy Sources	60	40	4
	BM - 705	Industrial Engineering	60	40	4

		Total Credit			**20**
Labora-tory	BM - 751	Dynamics of Machines and Mechanical Vibrations	20	30	2
	BM - 752	Industrial Engineering Turbo Machines and Solar Energy Lab	20	30	2
	BM - 753	Minor Project (2 Credits)	20	30	2
		Total Credit			**8**
		Total Marks = 650;	**Total Credits = 28**		

VIII - Semester

Course Type	Course Code	Course Title	End Semester Examination (Theory/Practical)	Sessional	Credits
Theory	BM-801	Product Design	60	40	4
	BM-802	Robotics	60	40	4
	BM-803	Automobile Engineering	60	40	4
	BM-804	Ergonomics	60	40	4
		Total Credit			**16**
Labora-tory	BM-851	IC Engine and Automobile Engineering	20	30	2
	BM-852	Seminar on Industrial Training	20	30	2
	BM-853	Project (4-credit)	60	40	4
		Total Credit			**8**
		Total Marks = 600;	**Total Credits = 24**		

CBCS COURSE STRUCTURE summary B. Tech. Mechanical Engineering (III to VIII semester)

No. of Theory Papers	14 + 6 + 6 +4	Total Credits
Total Credits Theory Paper	(4 x 14= 56) + (4 x 6 =24) + (4 x 6 =24) + (4 x 4 =16)	120
Total Credits lab		**40**
Total credits theory and lab		**160**

CBCS: Choice Based Credit System

SEC: Skill Enhancement Course

AECC: Ability Enhancement Compulsory Course

Course Structure Description

B.Tech.(Mechanical Engineering)

FIRST & SECOND Semester

COMMUNICATION SKILLS (AS- 101)

Unit I **THE ART OF COMMUNICATION**

English Communication, Technical, Verbal & Non-Verbal Communication, Barriers in Communication, The Art of Communication; Reading, Writing, Listening, Speaking and Strategies to overcome challenges in effective communication.

Unit II **FUNDAMENTALS OF ENGLISH SYNTAX**

Basics of Parts of Speech, Determiners, Use of tenses, Transformation of sentencesActive- Passive; Direct-Indirect; Simple-Compound-Complex sentences, Use ofPrepositions, Discourse Markers, Subject Verb Concord, Use of Conjunctions, Use ofVerbs.

Unit III **WRITING**

Formal & informal letters, unmade communication and Demand Communication Note Making, Report writing, Book Reviews, Abstracts and Research Proposals, creative writing, Email correspondences, Résumé writing, Executive summery.

Unit IV **WORD VOCABULARY & PHONETICS**

Word formation, foreign roots (Etymology), Suffix, Prefix, Antonyms, Synonyms, Homonyms, one-word substitution, Idioms and Phrases, Acronyms, IPA Symbols, Vowels and Consonants, Place and Manner of Articulations, Phonetic transcription and Accentuation (theoretical insight).

Unit V **LiteraturePoetry**

Where the Mind is Without Fear- Rabindranath Tagore
The Express- Stephan Spender
Amalkanti-NirendranathChkrabarti
Road Not taken- Robert Frost

Prose

Of Studies- Francis Bacon,
Vanishing Animals- Gerald Durrell
Fitin: Old man and the Sea – E Hemmingnoy
The Child- MunshiPremchand
Soapnut Leaves- Chaaso

Course Outcomes:

CO1: Understanding the concepts of communication and interfering barriers
CO2: Learning theoretical concepts of grammar
CO3: Commanding over the professional writing skills
CO4: Enhancing the reading and writing skills by the plays and poems
CO5: Understanding English phonetics with classification of consonant and vowels

Prescribed Textbooks:

1. *The Joy of Reading*: Orient Blackswan Pvt. Ltd, New Delhi
2. *Fluency in English*: Macmillan Publishers, New Delhi
3. Intermediate Grammar Usage and Composition: M.L.Tikoo and Subramanian , Orient

Blackswan Pvt. Ltd, New Delhi
4. A Text Book of English Phonetics for Indian Students: T. Balasubramanian, Macmillan Publishers, New Delhi.
5. Practical English Usage: Michael Swan, Oxford University Press.

Suggested Reading:

1. The Oxford Guide to effective Writing and Speaking Skills: John Seely, Oxford University Press
2. English Pronouncing Dictionary: Daniel Jones, Cambridge University Press.
3. Technical communication Principles and Practice: Meenakshi Raman and Sangeeta Sharma, Oxford.

HUMAN RESOURCE MANAGEMENT (AS-201)

Course Objective: The objective of the course is to enable the students to understand the key concept, systems and process about management of people and to provide a framework of using HR practices for organizational excellence. Moreover, Unit (II-V) will be both theoretical as well as experimental based. Unit (II-V) shall comprise of some elements of testing / lab exposure/ experiments.

Unit I (L-8) **Foundation of Human Resource Management (HRM)**: Meaning, definition, nature and scope, characteristic, objectives, Opportunities and challenges in HRM, HRM functions.

Unit II (L-8) **Acquisition of Human Resources:** *Human Resource Planning (HRP)*: need, objectives, determinates, HRP models, HRP process, type of HRP, benefits; *Job Analysis (JA)*: sources, methods, process, uses, importance; job description, job specification; *Recruitment and selection:* sources, process, barriers, objectives, objectives of selection, selection tests, interview, induction, placement and employee socialization.

Unit III (L-8) **Appraising and evaluating Human Resources:** *Performance Appraisal (PA)and feedback:* approaches, methods/techniques of PA, process of PA, interview, elements, designing and conducting PA; *Job Evaluation (JE):* principles, process, methods of JE, importance and limitations.

Unit IV (L-8) **Development of Human Resources:** *Human Resource Development (HRD):* functions, benefits, importance, barriers to HRD; *Training and Development*: models, methods, training process, training evaluation and barriers.

Unit V (L-8) **Employees Health &Wellbeing –Job stress and Job Burnout: Nature, Causes and consequences;** *Stress:* Nature, Causes and consequences; *Management of Stress:* Personal and organizational based strategies; *Burnout:* Nature, symptoms, causes, relationship with stress, burnout and job satisfaction management of burnout.

Course Outcomes:

CO1: Forming a Foundation of Human Resource Management.
CO2: Understanding the procedure of acquisition of Human Resources.
CO3: Making clear the importance of appraisals and evaluation in Human Resource Management.
CO4: Learning importance of training and development of Human Resources.
CO5: Analyzing the management of job stress and Employee health and well-being.

Prescribed Textbooks:

1. Gary Dessler (2015), Human Resource Management, Person Prentice Hall of India, New Delhi.
2. VSP Rao, Human Resource Management, Text & Cases (2nd edition), Excel Books, New

Delhi.

Reference books:

1. Tapomony Deb, (2009), Managing Human Resource and Industrial Relations (First edition), Excel Books, New Delhi
2. John M. Ivancevich (2005), Human Resource Management 93rd edition) Tata McGraw Hill Publishing Co. Ltd., New Delhi

Lab Excercies:

- Administration of relevant tests as per requirement of the content of unit. Such as job satisfaction & Personality tests, Job stress tests etc.
- Group activities; such as case studies as per topic of the unit.

INNOVATIVE TECHNOLOGY & BIO-SCIENCE (AS – 105)

Unit I **Introduction to Nanotechnology:**

Introduction to Nanotechnology, Theoretical Basis of nanotechnology, Quantum confinement and size effect, Classification of Nanomaterials: Nanowires, Quantum Well and Quantum Dots, Properties of Nanomaterials, Carbonaceous Nanomaterials and their examples. Molecular Nanotechnology, Green Nanotechnology.

Unit II **Applications of Nanotechnology**

Micro electro mechanical Systems (MEMS)&NanoeletromechanicalSystems(NEMS),Nanorobotics,Nanofluidics,Micro-gearsandNano-gears,Nano-compositesandtheirapplications,NanomaterialsforCivilEngineers, Nano-paints, Light and flexible Civil Engg. Structures based oncarbon Nanomaterials, Nano-memories. Nano- sensors. Nano-transistors, Introduction to organic electronics.

Unit III **Introduction to Biological Sciences**

Introduction to the cell as a unit of life, Principles involved in the maintenance of life processes, Ultra-structure and function of cellular components-Prokaryotic and Eukaryotic cells, cell wall, plasma membrane, endoplasmic reticulum, Biomolecules-Carbohydrates. Lipids, Amino Acids, proteins, Nucleic Acids, Tissue Systems. Metabolism, Chromosomes and CellDivision.BasicGenetics-biological indicators, bio-sensors, Mutation-causes, types and effect.

Unit IV **Advanced Biological Sciences**

Introduction to microbiology, Industrial microbiology, introduction to immunology, Introductiontomolecular genetics, Structure of RNA aid DNA, Concept of Gene, Gene regulation, Basicconceptsof biotechnology: Totipotency and cell manipulation, Classifications of biotechnologies

Unit V **Nano- biotechnology**

Introduction to Nano-biotechnology, Nanobiotechnology in medicine: regenerative medicine, Targeteddrug delivery. Nanotechnology in pharmacy, Nanobiotechnology in Ayurveda, Alternative medicines.Nanobiotechnology in Agricultural, industrial Nanobiotechnology, Nanoimaging, CancertreatmentusingNanotechnology.

Course Outcomes:

CO1: Introducing the concepts of nanotechnology.
CO2: Learning the applications of nanotechnology in multiple disciplines.
CO3: Introducing concepts of Biological Sciences and basic Genetics-bio indicators and biosensors.
CO4: Advancing the field of Biological Sciences and Biotechnology.
CO5: Introduction to Nano biotechnology and its various applications.

Reference books:

1. Introduction to Nanotechnology, by Charles P. Poole, Jr., Frank J. Owens, John Wiley

&Sons, 2003.
2. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, by Guozhong Cao, Ying Wang. World Scientific publishing, 2011.
3. Nanoscience: Nanobiotechnology and Nanobiology, edited by Patrick Boisseau, Marcel Lahmani, Springer, 2010.

ENGINEERING PHYSICS – I (AS – 102)

Unit I **PHYSICS OF MOTION**

Inertial and non-inertial frames, conservation principles of momentum and energy; many particle systems, rocket motion, simple harmonic motion, damped harmonic motion.

Unit II **OPTICS**

Two views about nature of light, concept of coherence, interference of light, single slit and N-slits diffraction, hydrogen atom spectrum, diffraction grating and spectral resolution.

Unit III **ELECTROMAGNETISM**

Cylindrical coordinates, Gradient, divergence and curl, line integral, surface integral and volume integral, Lorentz force, Gauss's law, Ampere's Law, Maxwell's equations, electromagnetic waves and Ponting vector.

Unit IV **QUANTUM IDEAS**

Difficulties of classical Physics, Planck hypothesis, wave particle duality, photoelectric effect, Compton effect, uncertainty principle and its implications, wave packets, group velocity and phase velocity, Davisson Germer experiment.

Unit V **PHYSICS OF MATERIALS**

Classifications of materials, crystal structure, unit cell and lattice parameters, Miller indices, Bragg's law and X-ray diffraction, classical free electron theory, its success and failures, Wiedemann Franz law, Maxwell Boltzmann distribution.

Course Outcomes:

CO1: Enhancing the concepts of conservative and non-conservative forces.
CO2: Understanding the basics of optics and introduction to lasers.
CO3: Expanding the concepts of electromagnetism.
CO4: Exploring the basics of quantum Ideas: photoelectriceffect, Cromptoneffect, Planck hypothesis etc.
CO5: Understanding the physics of solid.

Reference/ Text books:

1. Resnick Halliday: Physics
2. Beiser: Modern Physics
3. Mani and Mehta: Modern Physics
4. Garcia and Damask: Physics for computer science
5. Thyagrajan: Laser

ENGINEERING CHEMISTRY – I (AS – 103)

Unit I **CHEMICAL AND INSTRUMENTAL METHODS OF ANALYSIS**

Gravimetric Analysis; Digestion and its Importance, Favorable Conditions for Precipitation, Volumetric Methods of Analysis; Expression of concentration of solutions Acid-Base (pH metry and conductometry), Redox, Precipitation and Complex Metric Titrations. Chromatography; Definition and Different Types of Chromatography, Fundamentals of Spectroscopy; Principles and Applications of UV-Visible, Infra-Red and Atomic Absorption Spectrometry.

Unit II **ELECTROCHEMISTRY AND SURFACTANTS**

Electrolytic and Galvanic cell, Electrode Potential, Standard Electrode Potential, EMF series, Nernst Equation, Cell emf Measurement, Reversible and Irreversible cell, Thermodynamic Overview of Electrochemical Processes, Conductance, Cell Constant and its Determination. Surface Active Agents, Soaps, Types and Advantages of Detergents, Critical Miceller Concentration, Hydrophilic and Hydrophobic Interactions, HLB values, Fricoohesity of Surfactant Solutions.

Unit III **MOLECULAR STRUCTURE AND PHASE RULE**

Valence Bond Theory, Molecular Orbital Theory, Molecular Orbital of Polyatomic Molecules, Molecular orbital Theory of Solids crystal structure, Semiconductors and Superconductors. Phase Rule; Phase Rule Applications to One and Multiple Component systems, Fe-C Phase Equilibrium Diagram, Types of Alloys, Ferrous and Nonferrous Alloys.

Unit IV **POLYMERS AND COMPOSITES**

Basics of polymer chemistry, Molecular weight, Glass transition temperature and Melting point, Methods of polymerization, Structure property relationship, Thermoplastics and Thermosets, Fabrication of polymers-Compression, Injection, Extrusion, Moulding. Synthesis, Properties and uses of polyethylene, Polyvinyl Chloride, Ploy Methyl Methacrylate, Urea formaldehyde resin and Melamine formaldehyde resin, Elastomers, Conducting polymers, Adhesives and their mechanism of formation, Composites; Compositions, Characteristics and their types.

Unit V **NANOMATERIALS**

General Introduction, Fullerenes, Carbon nanotubes, Nanowires, Electronic and Mechanical properties, Synthesis of nanomaterials, Top down and Bottom up approaches, Applications of nanomaterials. Applications of biotechnology.
Alloys: Types, ferrous/Non-ferrous (Carbon Steel Alloy).

Course Outcomes:

CO1: Explaining the knowledge of Chromatography, spectroscopy and carious methods of chemical analysis.
CO2: Exploring the basics of reaction dynamics, catalysis and electrochemistry.
CO3: Expanding the concepts of molecules and solid state as well as the idea of phase rule and the phase diagram.
CO4: Understanding the mechanism and classification of various polymers

CO5: Introducting the concepts of Nano- materials, their synthesis ad applications.

Reference/ Text books:

1. "Basic Inorganic Chemistry" Cotton, F A Wikkinson G. and Gaus, P L John Willey & Sons. Inc. Singapore, 3rd Edition. 1996.
2. Engineering Chemistry by Jain & Jain
3. University General Chemistry by Petersykes, Orient Longman.
4. Instrumental methods & analysis by Willard, Merritt Deam, settle.
5. Analytical chemistry by Gary d. Christian.
6. Engineering chemistry by Dr. SunitaRatan.

ENGINEERING MATHEMATICS (AS – 104)

Unit I **CURVE TRACING & APPLICATIONS OF DEFINITE INTEGRALS**

Two-Dimensional curve tracing in Cartesian, polar and parametric forms, Double points & points of inflexion, Oblique and parallel asymptotes, Finding length, volume and surface area of the curve in Cartesian, polar and parametric forms.

Unit II **TECHNIQUES OF ONE VERIABLE CALCULUS & PARTIAL DIFFERENTIATIONS**

Leibnitz's theorem; nth derivative of F(x) at x=0, Maclaurin's expansion of F(x), Formation of Intrinsic and pedal equations, Partial derivatives and their geometrical interpretation, Total derivative, Total differential coefficient, change of variables i.e. use of Jacobeans.

Curvature and radius of curvature in Cartesian, polar and parametric and implicit forms, Radius of curvature at the origin, centre and chord of curvature, and evolutes of the curves.

Unit III **CALCULUS OF SEVERAL VARIABLES & LINEAR ALGEBRA**

Taylor's expansion of a function of one & two variables, Leibnitz's rule for differentiation under the sign of integration, Maxima and minima of a function of two and more variables including Lagrange's method.

Consistency of a system of simultaneous linear equations using rank, Eigen values and Eigen vectors of a square matrix, Properties of Eigen values, Applications of Cayley-Hamilton theorem and diagonalization of a matrix, vector space, basis, linear dependence and independence of vectors, Linear transformations and related problems.

Unit IV **ORDINARY DIFFRENTIAL EQUATIONS**

Orthogonal and Isogonal trajectories of a family of curves, Complementary function, particular integral and general solution of ordinary linear differential equations of higher order with constant and variable coefficients (Cauchy and Legendre forms).

Method of variation of parameters Method of undetermined coefficients and solutions of simultaneous differential equations with constant coefficients.

Unit V **PARTIAL DIFFERENTIAL EQUATIONS**

Introduction to partial differential equations, Change of independent variables in P.D.E., Complete solution of homogeneous and non-homogeneous L.P.D.E. of higher order with constant and variable coefficients,

Solutions of one dimensional wave equation, one dimensional heat conduction equations and two-dimensional Laplace (Cartesian and polar forms) equation using method of separation of variables.

Course Outcomes:

CO1: Curve tracing and application of definite integrals
CO2: Techniques of one variable calculus & partial differentiation.
CO3: Calculus of several variables and matrix theory.
CO4: Ordinary differential equations.

CO5: Partial differential equations.

Reference/ Text books:

1. A.B. Mathur& V.P. Jaggi: A text book of "Engg. Maths. & Advanced Engg. Mathematics"
2. V.P.Mishra: "Concept of Engineering Mathematics" (Revised Edition)
3. B.S. Grewal: "Engineering Mathematics & Higher Engineering Mathematics"
4. B.V. Ramana: "Higher Engineering Mathematics".
5. R.K. Jain and S.R.K. Iyengar : "Advanced Engineering Mathematics", 4th Edition
6. "Applied Mathematics": Dr. J.S.Bindra&K.S. Gill, S.K. Kataria& Sons, Ansari Road, Darya Ganj, Delhi-110002.

ENGINEERING PHYSICS – II (AS – 202)

Unit I **RELATIVITY**

Difficulties of classical theory, idea of ether, Michelson Morley Experiment, Galilean transformations, postulates of special theory of relativity, Lorentz transformations, Einstein velocity addition theorem, time dilation, length contraction, relativistic mass, momentum and energy, natural units, principle of equivalence.

Unit II **LASERS**

Principle of laser action, Einstein's transition probabilities, lifetime of transitions, rate equation for atomic transition, optical resonators, ruby laser, He-Ne laser, general characteristics of lasers, applications of lasers.

Unit III **QUANTUM THEORY**

Schrodinger equation, time dependent and independent forms, wave function, probabilistic interpretation, one-dimensional problems, particle in a box, elementary treatment of harmonic oscillator, potential barrier and possibility of tunneling.

Unit IV **PHYSICS OF MATERIALS**

Bose Einstein statistics, Fermi Dirac statistics, semiconductors, intrinsic and extrinsic, carrier concentration, origin of energy gap, Kronig Penney model, Basics of semiconductor devices and applications, Electrical & optical properties.

Unit V **FRONTIERS OF PHYSICS**

Basic interactions, symmetry, invariance and conservation laws, elementary particles and their classification, accelerator physics and applications, last Nobel Prize in Physics, its back ground, significance and possibilities of future developments.

Course Outcomes:

CO1: Beginning with the idea of special theory of relativity.
CO2: Understanding the principles of Laser and their applications.
CO3: Exploring the concepts of Quantum theory of physics.
CO4: Analyzing the Physics of solids and understanding properties of variousmetals and semi-conductor solids.
CO5: Study of the Frontiers of physics and current Nobel Prize in Physics.

Reference/ Text books:

1. Resnick Halliday: Physics
2. Beiser: Modern Physics
3. Mani and Mehta: Modern Physics
4. Garcia and Damask: Physics for computer science
5. Thyagrajan: Laser

ENGINEERING CHEMISTRY & ENVIRONMENTAL SCIENCE- II (AS -203)

Unit I **WATER TREATMENT:**

Water Quality Parameters (BIS & WHO Standards), types of hardness, Units, Determination of hardness by EDTA method, Alkalinity of water & its significance, Numerical problems, Problems with boiler feed water and its treatment; Scale & Sludge formation, Boiler corrosion, Caustic embrittlement, Priming & foaming, Softening methods; Lime-soda, Zeolite & Ion Exchange processes, Numerical problems, Chlorination of water, Coagulation, Sedimentation and Desalination.

Unit II **ENERGY RESOURCES:**

Types of fuels, Calorific values, (HCV & LCV) and determinations by Bomb and Boys gas calorimeter, Numerical problems, Coal; Types of coal, Analysis of coal, Liquid Fuel; Refining of petroleum, Knocking, Octane and Certance Values, Pollution from fossil fuels, Combustion and Problems. Renewable; (Solar Cells, Rechargeable Batteries, Fuel Cells) and Non-renewable of energy; (Wind Energy, Geothermal Energy, Ocean Energy) resources of Energy.

Unit III **CORROSION AND ITS PROTECTION:**

Corrosion; Definition and its scope, Chemical Corrosion, Electrochemical Corrosion, Mechanism of Chemical and Electrochemical Corrosion, Types of Corrosion; Intergranular Corrosion, Soil Corrosion, Waterline Corrosion, Differential Aeration Corrosion, Galvanic and Concentration Cell Corrosion, Factors affecting corrosion, Protection of corrosion.

Unit IV **ENVIRONMENTAL CHEMISTRY:**

Environment and its Segments, Zones of Atmosphere, Air Pollution: Air pollutants and their resources; Aerosol and its Types, RSPM, SPM, Acid rain, Green House Effect, Global warming, Ozone Layer Depletion, Water Pollution; Sources of water pollution, Sewage Treatment, Determination and Significance of COD, BOD, TOC. Noise Pollution, Soil Pollution, Radioactive Pollution and e-Waste.

Unit V **ENVIRONMENTAL BIOTECHNOLOGY:**

Biotechnology and its applications, fermentation, production of alcohol and vitamins, Biotechnology for environmental Protection, Biological indicators, biosensors, bioremediation, Phytoremediation, bio-pesticides, bio-fertilizers, bioreactors, Social issues, biodiversity and its conservation.

Course Outcomes:

CO1:Understanding the importance of various water impurity problems and thusWater Treatment.
CO2: Understanding various parameters of Fuels and their proper combustion.
CO3: Exploring the ideas about corrosion in metals and its remedies.
CO4: Imparting the knowledge of environmental chemistry.
CO5:Environmental biotechnology and social issues.

Reference/ Text books:

1. A Basic course in Environmental studies by S. Deswal and A. Deswal.
2. Fundamental of Environments studies by MahuaBasu and S. Xavier.
3. Engineering chemistry by P.C.Jain.
4. Engg. Chemistry by Dr. SunitaRatan.

ENGINEERING MATHEMATICS – II (AS – 204)

Unit I **SOLID GEOMETRY & MULTIPLE INTEGRALS**

Formation of equations of cylinder and cone under the given geometricalconditions, Tracing of some quadric (or Conicoids) three dimensional surfaces.

Evaluation of multiple integrals by change of order of integration, Change of variables i.e. Use of Jacobian& Applications of multiple integrals in finding plane area, mass, centre of gravity, centre of pressure, moment of inertia, product of inertia, curved surface area and volume.

Unit II **ORDINARY& PARTIAL DIFFERENTIAL EQUATIONS**

Ordinary point and regular singular point, Series solutions of ordinary differential equations of second order with variable coefficients (polynomials) by the method of Frobenius; Lagrange's method of undetermined multipliers for the solution of linear partial differential equations of first order solution of non-linear partial differential equations of first order by means of transformations and Charpits methods.

Unit III **COMPLEX ANALYSIS**

Analytical function, C-R equations in Cartesian and polar forms, Geometrical representation of $\omega=F(z)$, Determination of conjugate harmonic function, Milne – Thomson meyhod and related problems; Evaluation of complex integrals using Cauchy's integral theorem, Cauchy's integral formula for the nth order derivative of an analytic function.

Taylor series, Maclaurin series and Laurent series expansions of functions, Conformal mapping, sufficient condition for conformality of $W=f(z)$, some standard transformations; zeros, singularities and residues of an analytic function, Application of Cauchy's residue theorem in solving contour integrals and evaluation of real definite integrals using residue method.

Unit IV **LAPLACE TRANSFORM & ITS APPLICATIONS**

Laplace and inverse Laplace transforms of some well-known elementary functions and Special functions, Change of scale property, First and second shifting theorems, Laplace transforms of Derivative, Integral, $tnf(t)$, $f(t)/t$, Convolution theorem & Periodic function.

Applications of Laplace and inverse Laplace transform in finding the particular solutions of ordinary linear differential equations with constants and variables coefficients, system of differential equations, integral equation, Integro-differential equations, difference equations and, conversion of differential equations into integral equations & vice versa.

Unit V **FUZZY MATHEMATICS**

Fuzzy set, elements of Fuzzy logic, Relations including operations, reflexivity, symmetry and transivity, Pattern classification based on fuzzy relations, fuzzy analysis including metric spaces, distance between fuzzy sets, area perimeter, height, width of fuzzy subsets, continuity & integrals.

Course Outcomes:

CO1: Understanding solid geometry and methods of evaluation of multiple integrals.
CO2: Studying various methods of ordinary and partial differential equations.
CO3: Analysis of Complex Functions.
CO4: Building basics and applying Laplace transforms.
CO5: Studying Infinite series and their convergent and divergent behavior.

Reference/ Text books:

1. A.B. Mathur& V.P. Jaggi: "Engineering. Mathematics & Advanced Engineering Mathematics" (two volume)
2. V.P.Mishra: "Concept of Engineering Mathematics" (Revised Edition)
3. B.S. Grewal: "Engineering Mathematics & Higher Engineering Mathematics",43rd Edition
4. B.V. Ramana: "Higher Engineering Mathematics".
5. R.K. Jain and S.R.K. Iyengar : "Advanced Engineering Mathematics" 4th Edition

BASICS OF ELECTRONICS & COMMUNICATION ENGINEERING (ECS– 201)

Unit I **SEMICONDUCTOR DIODES:**

P-N junction diode, V-I characteristics, static and resistance, linear and non-linear applications of diodes; half wave, full wave and bridge rectifiers, Zener diode, characteristics and its use as a voltage regulator, AND, OR, NAND, NOR and Ex-OR gates.

Unit II **TRANSISTORS (BJT&JFET):**

Bipolar junction transistor (BJT), biasing and amplifier action, load line analysis of transistor amplifier, BJT amplifier configurations and their comparison using small signal h-parameter model, Junction field Effect transistor (FET), biasing and amplifier action.

Unit III **OPERATIONAL AMPLIFIER:**

Op-am- basics, practical p-ampcircuits, inverting and non-inverting amplifier, summing amplifier, integrators and differentiators.

Unit IV **FEEDBACK AND ELECTRONIC INSTRUMENTS:**

Feedback concept, Barkhausen Criteria of oscillation, Wein Bridge and phase shit oscillator, cathode Ray oscilloscope (CRO), electronicsmultimeters.

Unit V **COMMUNICATION SYSTEMS:**

Introduction to modulation, amplitude modulation generation of AM waves, demodulation of AM wave, introduction to FM.

Course Outcomes:

CO1: Studying semiconductor diodes and their various characteristics.
CO2: Expanding the ideas: construction and working of BJTs and introducing JFET.
CO3: Exploring various types of Operational Amplifiers.
CO4: Understanding the idea of Feedback and thus studying various Electronic Instruments.
CO5: Introduction to various parameters of Communication Systems.

Text books/ Reference books:

1. Microelectronics 2nd Edition, by 1 Millman and A. Grabel, Mc Graw Hill International Edition 1988.
2. Electronic Devices and Circuit Theory 5th Edition, by Robert boyestadandLouisnashlesky, PH1 1992
3. Electronic Circuits – discrete and Integrated, by Schilling and Belove , Mc Graw Hill International Edition, 1988.

BASICS OF ELECTRICAL ENGINEERING (EE – 101)

Unit I **DC NETWORKS:**
Kirchhoff's Laws, Node Voltage and Mesh Current Methods; Delta-Star Delta Conversion, Classification of Network Elements; Superposition Principle; Thevenin's& Norton Theorem.

Unit II **AC CIRCUITS:**
Single Phase EMF Generation, Average and effective values of sinusoids; Solution of R, L, C Series Circuits, the j operator, complex representation of impedances; Phasor diagram, Power Factor, Power in Complex Notations; Solution of parallel and series parallel circuits; Resonance; Introduction to three phase balanced circuits.

Unit III **MAGNETIC CIRCUITS:**
Amperes Circuital Law; B-H Curve; Solution of Magnetic Circuits; Hysteresis and Eddy Current Losses; Relays: An application of Magnetic force.

Unit IV **TRANSFORMERS:**
Construction, EMF Equation, Rating, Phasor Diagram on no load and full load. Equivalent Circuit Regulation and efficiency calculations; Open and Short Circuit Tests.

Unit V **DC MACHINES:**
Construction, EMF and Torque Equations; Characteristics of DC Generators & Motors; Speed Control of DC Motors and DC Motor Starters; Introduction, Working Principle, Ratings, Equivalent Circuits of Single Phase Induction Motors.

Unit VI **ELECTRICAL MEASURING INSTRUMENTS:**
DC PMMC Instruments, Shuts and Multipliers, Multimeters; Moving Iron Ammeters and Voltmeters; Dynamometer Wattmeters; AC watt-hour meters, Extension of Instrument ranges.

Course Outcomes:
CO1: To impart a basic knowledge of DC networks and fundamentals
CO2: To impart the basic knowledge about the Electric and Magnetic circuits.
CO3: To inculcate the understanding about the AC fundamentals.
CO4: To understand the working of various Electrical Machines.
CO5: To know about various measuring instruments and house wiring.

Text books/ Reference books:

1. Electrical Engineering Fundamentals (Second Edition) by Vincent Del Toro, Prentice Hall of India (Pvt.) Ltd.,
2. Electrical Technology (E.L.B.S., Text Book Series) by Edward Hughes, Longmans, Green and Co. Ltd.
3. Advanced Electrical Technology by H. Cotton, CBS publishers and Distributors
4. Electrical Measurements by F.K. Harris, Wiley Eastern (P) Ltd.
5. Foundations of Electrical Engineering Second Ed. by Cogdell IR. Prentice Hall.

6. Problems in Electrical Engineering, Tenth Edition, by Parker Smith S. (Ed Parker Smith N.N.) Asia Publications.

FUNDAMENTALS OF COMPUTING (CS-101)

Unit I **BASICS OF COMPUTERS:**

Computer fundamentals, Bits and Bytes, Generations of Computers, Classification of Computers, CPU, Memory, Input and Output Devices, Applications Software & System Software, Number system: Decimal, Binary, Octal, Hexadecimal.

Unit II **C PROGRAMMING:**

Flow Chart, Algorithms, The C character set, constants, variable, keywords, operator and expressions, decision controls, loops, case, functions, call by value and by reference, array, single dimensional, 2 dimensional, multidimensional arrays, Basic Concept of pointers & Structure.

Unit III **SEARCHING & SORTING:**

Searching and Sorting techniques, linear search, Binary Search, Bubble Sort, Strings, library string functions.

Unit IV **OPERATING SYSTEM:**

OS definition, Role of OS in computer system, multi programming, time sharing, multitasking, multiprocessing, Multiprocessor andits type, cluster system, Real Time system, Client Server Computing, distributed OS, function of OS, user interface, CLI & GUI.

Unit V **NETWORKING & DBMS:**

Network, communication models, transmission media, connection topologies, LAN, WAN, MAN, ISO-OSI model of networking, Internet, ISP, WWW, Email, URL, Web browsers, websites, intranet. DBMS, DBMS applications, Advantage of DBMS, Data Model.

Course Outcomes:

CO1: To impart a basic knowledge of computer fundamentals.
CO2: To teach C programming and related algorithm.
CO3: To inculcate the understanding of searching and sorting techniques.
CO4: To understand operating systems and multiprogramming.
CO5: To understand the working of various networking tool and data base management system and their applications.

Text books/ Reference books:

1. Fundamentals of Computers by V. Rajaraman, PHI.
2. Peter Norton, “Introduction to Computers, Tata Mc-Graw Hill.
3. M N Doja, “Introduction to Computers and Information Technology”
4. B. A. Forouzan, “Data Communication and Networking”, TMH, 4th Ed
5. "An Introduction to Database Systems", C. J. Date, Pearson Education.”
6. “Let Us C” by YashwantKanetkar, BPB Publication”.

ELEMENTS OF CIVIL &ENVIRONMETAL ENGINEERING (CE- 101)

Unit I **STRESSES & STRAINS:**

Introduction, normal stress & strain shear stress & strain, relationship between stress and strain, Uniaxial tension test: Stress-Strain diagrams for different materials, Mechanical properties of materials, Uniaxial deformations: Saint Venant's principle, principle of superposition, free body diagrams, bars of uniform cross sections. Uniaxial Deformations: bars of variable cross sections, compound/composite bars, temperature stress.

Unit II **ANALYSIS OF STRESSES:**

Tensor notations, equilibrium equations, transformation of stresses, invariants of stress tensor, Plane stress condition, principle stresses, maximum shear stress and their planes, Mohr's circle.

Unit III **ANALYSIS OF STRAINS:**

Transformation of strains, invariants of stain tensor, plane strain condition, principle strains, maximum shear strain and their planes; Strain Rosettes; Stress-Strain relationship, generalized Hooke's law, relation between elastic constants.

Unit IV **BASICS OF ENVIRONMENTS:**

Adverse Effect of Environmental Pollution, Pollution Control Strategies, Air Pollution: Sources, Effects on Human Health, Vegetation and Materials, Global Warming, Acid Rains, Ozone Depletion-Causes, Effects and Control.

Unit V **POLLUTIONS AND CONTROL:**

Water Pollution, Sources of Water Pollution, Effects of Water Pollution, Water Borne Diseases, Water Quality Standards, Water Pollution Control. Noise Pollution, Indoor and Outdoor sources of noise pollution, Effects of Noise Pollution, Noise Standards, Noise Pollution controls.

Course Outcomes:

CO1: Introduction to stress and strain and learning the mechanical properties of materials.
CO2:Analysis of stress with tensor notations, equilibrium equations and various transformations.
CO3: Analysis of strain with invariants of strain tensor, plain strain conditions and relation between elastic constants.
CO4: Learning the basics of environment with effect of pollution and controlling strategies.
CO5: Understanding water and noise pollution along with its source, effects and related diseases.

Reference/ Text books:

1. Engineering Mechanics of solids by E.P.Popov, Pearson Education.
2. Solid Mechanics by S,M,A.Kazimi, Tata Mcgram Hill.
3. Basics civil and Environmental Engineering by C.P. Kaushik, S.S. Bhavakatti and AnubhaKhaushik.

CBCS Course Structure (2017)B. Tech. MECHANICAL ENGINEERING- I & II semesters

(All Branches/ Sections)

SEMESTER	I		II	
Section	**Course Name (Course code)**	**Course Type**	**Course Name (Course code)**	**Course Type**
A	Workshop Practice (ME-151)	Practical	Basics of Mechanical Engineering (ME-101)	Theory
			Workshop Practice (ME-151)	Practical
			Engineering Mechanics Lab. (ME-102)	Practical
B	Workshop Practice (ME-151)	Practical	Basics of Mechanical Engineering (ME-101)	Theory
			Workshop Practice (ME-151)	Practical
			Engineering Mechanics Lab. (ME-102)	Practical
C	Basics of Mechanical Engineering (ME-101)	Theory	Engineering Graphics (ME-250)	Practical
	Workshop Practice (ME-151)	Practical		
	Engineering Mechanics Lab. (ME-102)	Practical		
D	Basics of Mechanical Engineering (ME-101)	Theory	Workshop Practice (ME-151)	Practical
	Engineering Graphics (ME-250)	Practical		
	Engineering Mechanics Lab. (ME-102)	Practical		
E	Basics of Mechanical Engineering (ME-101)	Theory	Workshop Practice (ME-151)	Practical
	Engineering Graphics (ME-250)	Practical		
	Engineering Mechanics Lab. (ME-102)	Practical		

BASICS OF MECHANICAL ENGINEERING (ME-101)

Course Objectives: To expose the students to the thrust areas in mechanical engineering and their relevance by covering the fundamental concepts

Unit I **KINEMATICS OF RIGID BODIES:**
Translation, Rotation About a Fixed Axis, General Plane Motion, Absolute & Relative Velocity and Acceleration in Plane Motion, Instantaneous Center of Rotation in Plane Motion, Analysis of Plane Motion in Terms of a Parameter, Rate of Change of a Vector with Respect to a Rotating Frame, Plane Motion of a Particle Relative to a Rotating Frame, Coriolis Acceleration, Motion About a Fixed Point. General Motion, Three-Dimensional Motion of a Particle Relative to a Rotating Frame, Coriolis Acceleration, Frame of Reference in General Motion

Unit II **PLANE MOTION OF RIGID BODIES:**
Forces and Accelerations: Equations of Motion & Angular Momentum of Rigid Body in Plane Motion, D'Alembert's Principle, Axioms of the Mechanics of Rigid Bodies, Systems of Rigid Bodies, Constrained Plane Motion, Energy and Momentum Methods Principle of Work and Energy for Rigid Body, Work of Forces Acting on a Rigid Body, Kinetic Energy of a Rigid Body in Plane Motion, Systems of Rigid Bodies, Conservation of Energy, Power, Principle of Impulse and Momentum for the Plane Motion of a Rigid Body, Conservation of Angular Momentum.

Unit III Properties, Macroscopic Versus Microscopic View point, Thermodynamic System and Control Volume, Processes and Cycles,ThermodynamicEquilibrium,Quasi-Static Process, Concept of Continuum Thermostatic, Units and Dimensions Work Transfer, P-dV Work or Displacement Work, Other Types of Work Transfer and Heat Transfer – A Path Function, Specific Heat and Latent Heat, Work Transfer.
ZerothLaw of Thermodynamics, Measurement of Temperature, Ideal Gas Thermometers, Celsius Temperature Scale, Electrical Resistance Thermometer, Thermocouple.

Unit IV First Law of thermodynamics for a Closed System Undergoing a process and a Cycle, Energy-A Property of the System, Different Forms of Energy, Specific Heat at Constant Volume, Enthalpy, Specific heat at Constant Pressure. Energy of an isolated system.
First Law Applied to Flow Processes, Control Volume, steady Flow Process, Mass Balance and Energy Balance in a Simple and Steady Flow Processes; Comparison of S.F.E.E. with Euler and Bernoulli Equations, Numerical

Unit V Second Law of Thermodynamics, Thermal reservoirs, heat pump and refrigerator, Statements of second law of thermodynamics, Kelvin Planck and Clausius statements and their equivalence, Carnot's theorem, Clausius inequality; Numerical

Course Outcomes:

CO1: Understanding various thermodynamic systems, properties and other related concepts.
CO2: Expanding the knowledge of reversible and irreversible cycles.
CO3: Learning the basics of first law and second law equation and related theories with numerical.
CO4: Studying the kinematics of fluid flow.
CO5: Understanding the dynamics of fluid flow.

Text books:

Vector Mechanics for Engineers: Statics and Dynamics, Tenth Edition: by Ferdinand P. Beer, E. Russell Johnston, Jr., David F. Mazurek, and Phillip J. Cornwell, Tata McGraw Hill.

Reference books:

1. Engineering Thermodynamics by: P. K. Nag, TMH.
2. Fundamental of classical thermodynamics by: Wan- Wylen&sontag, John wiley&sons.
3. Engineering thermodynamics by: Spalding & code.
4. Engineering Mechanics: Statics and Dynamics: by J. L. Meriam and L. G. Kraige, John Wiley & Sons, Inc.
5. Engineering Mechanics: Dynamics: 12th Edition by R. C. Hibbeler, Prentice Hall
6. Engineering Mechanics: by K.L. Kumar, Tata Mc Graw Hill.

WORKSHOP PRACTICE (ME-151)

I **FOUNDRY:**

Mould cores, core prints, gates runner, risers, chaplets, common defects in casting, defects due to mould, metal pouring, solidification.

II **METAL JOINING:**

Oxy acetylene gas welding equipment, types of flame, electric arc and contact welding, electrodes and equipments for AC and DC welding, electrode coating functions and constitutes, common welding defects.

III **METAL CUTTING OPERATION AND TOOLS:**

Common metal cutting machine like lathe, milling, shaper, slotter and drill, lathe operations like turning, chamfering, facing, taper turning and knurling, material for lathe tools and other tools, bench grinder and use.

Related Ibs

1. Gas welding: simple joint like joint.
2. Electric Arc Welding: Simple joints like butt joint.
3. Tin Smithy: Mechanical joining, jobs like box, tray, funnel and soldering of joints.
4. Turning: Plane turning, taper turning, threading, knurling, facing and chamfering on the same job.
5. Shaping: Surface finishing at right angles.
6. Milling: Making a slot two or three surface finishing at angles of 120^0C.
7. Drilling: Making drilled holes in plates or flats and grinding the corner of a plate to round.

Text books/ Reference books:

1. Elements of Workshop Technology by, Choudhary Vol. 1 & 2. Media promoters and publisher, 1996.
2. Workshop Technology, Vol. 1-3 by W A J Chapman, ELB. S

ENGINEERING GRAPHICS (ME-250)

Unit I **ORTHOGRAPHIC PROJECTION:**

Conversion of pictorial/ isometric views into orthographic views of machine block. Identification of surface in orthographic views. Some practice on auto-Cad package.

Unit II **ISOMETRIC PROJECTION:**

Isometric scale, isometric projection of solids, missing line and missing views. Isometric view of simple objects when their orthographic views are given. Preparation of isometric views using Auto-Cad package.

Unit III **SECTIONING:**

Conventional representation in section of engineering materials. Methods of sectioning, sectional views of machine components, brackets, bushed bearing and foot step bearing.

Unit IV **FASTENERS:**

Sketches of different types of threads, permanent fasteners (riveted and welded joints), temporary fasteners (nut and bolt assembly, studs, keys. etc.)

Unit V **BUILDING DRAWINGS:**

Symbols of electrical and sanitary items. Terminology used in building drawing, plan and elevation of 2/3- rooms building using Auto-CAD package, from corrosion, refractories, their manufacturer and properties: neutral, acid and basic refractors; glass its types and manufacture.

Text books/ Reference books:

1. Chemistry of Engineering Materials, C. / V. Aggarwal, Tara Book Agency Varansi.
2. Chemistry in Engineering and Technology, Kuriacose& Raja Ram, Tata McGraw Hill.
3. Engineering chemistry, B. K. Sharma, P C Jain, Dhanpat Rai and Sons.

Course Structure Description B.Tech.

(Mechanical Engineering)

THIRD Semester

MECHANICS OF SOLIDS

Paper Code	**BM – 301**
Course Credits	**4**
No. of Lectures / week	3
No. of Tutorials/week	1

Course Description

Unit - I

Introduction: Concept of stress at a point, Principle stress and strain due to combination of stresses.

Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts. Power transmitted by shafts; combined bending and torsion. Composite shaft-series connection

Material properties and Testing: Properties in tension, shear and compression. Tension and other tests. Impact test. Fatigue test Creep test. Hardness test. Correlation of properties. Description of machines and equipment for different tests.

Unit - II

Shear force & Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, udl., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections.

Unit - III

Deflection of Beams: Area moment method. Application of area moment method to cantilever, simply supported and indeterminate beams. Advantages and disadvantage of fixed and continuous beams. Energy method. Strain energy and strain energy density. Strain energy of beam for bending and shearing stresses. Impact loading on beams.

Castigliano's theorem and calculations of deflection of beams under single and several loads due to bending and deflection due to shear.

Unit - IV

Columns & Struts: Stability of columns. Critical loads for columns under different end conditions. Euler's and Secant formulae. Rankine formula. Design of columns under centric load Eccentrically loaded columns and their design. Kernel of a section. Laterally loaded columns.

Unit - V

Experimental Stress Analysis: Measurement of strain at a point, effect of strain gradient. Requirements of a strain gauge. Different types of strain gauges;

	Mechanical, Optical, Acoustical and Electrical gauges. Measurement of Stress by electrical wire resistance strain gauge, Strain sensitivity of a conductor. Material for strain gauge construction of strain gauge. Strain Gauge fixing and connections. Temperature strains. Gauge factor. Introduction to Strain Rosette, Analysis of rectangular rosette, Δ rosette and T rosette.
Pre-Requisite Courses (/ Papers):	• Engineering Mechanics • Elements of Civil Engineering
Text books:	• Mechanics of Solids by Abdul Mubeen, Pearson Education • Introduction to Solid Mechanics by Shames, Prentice Hall of India Pvt. Ltd
Reference books:	• Experimental Stress Analysis by Abdul Mubeen, Dhanpat Rai and Sons. • Experimental Stress Analysis by Dally & Riley, McGraw -Hill Book Co. • Advanced Mechanics of Materials by Steel and Smith, John Wiley and Sons • Experimental Strength of Materials by Abdul Mubeen, Khanna Publishers
Course Objective	• Review and apply the principles of static equilibrium to the analysis of structures such as pressure vessels, beams, and torsion members; • Evaluate stress and strain within various structures by applying the appropriate engineering theories; • Formulate solutions to problems requiring the application of suitable engineering theories for stress and strain.
Course Outcomes	CO1: Formulating the fundamentals of engineering applications of stress and strain; and Material properties and testing. CO2: Developing the concept of Shear force and Bending moment, and formulating flexural and bending stresses. CO3: Formulate solutions to problems requiring the application of theories of deflection of beams. CO4: Recognise the principal terminology and concepts for columns and strut designing. CO5: Recall the principal analytical and graphical methods used to analyse experimental stress and strain.
Computer Usage / Software required:	ANSYS, SOLIDWORKS, MATLAB
Other details regarding this course	This course is of predominant importance in understanding the advanced subjects relating to Machine Component Design and Dynamics

MANUFACTURING PROCESSES

Paper Code	**BM – 302**
Course Credits	**4**
No. of Lectures/week	**3**
No. of Tutorials/week	1

Course Description

Unit-I

Introduction: Machine Tool: Classification and function, operations and working principles. Basic elements of machine tool; slide and slide ways, Machine tool drives. Types of Machine tools.

Unit-II

Lathe and Milling: Tools, Classification, tool geometry, speed, feed and depth of cut, effect of machining parameters on surface roughness. Lathe operations; Facing, Turning, Shouldering of cylindrical shapes, drilling, reaming, boring, taper turning by different methods, thread cutting, method of cutting multiple thread.

Milling Machine, working principle, milling operations (slab, end, slot milling), cutting speed and feed, estimating machining time, different types of indexing methods.

Unit-III

Drilling: Types of drilling machines, portable, bench, upright, Radial, Multiple spindle and horizontal milling machine. Spot facing and lapping. Cutting speed, feed and depth of cut. Estimating machine time.

Reaming: Types of reamer, Reaming operations.

Broaching: Types of broaches, tool material, teeth terminology and other details. Types of broaching machines. Machine size. Methods of broaching. Shaping, planning and slotting.

Unit-IV

Welding: Different types of welding; welding principle, principles of fusion welding, Heat Source. Emission and ionization of electric arc, Arc structure, Characteristic and power of electric arc, Modes of metal transfer in Arc welding. TIG, MIG, Resistance, Electro-slag, spot, Thermit, Friction stir welding and Laser beam welding.

Unit-V

Casting Processes: Introduction, Pattern and mould, Pattern allowances, types of pattern, types of mould (Grey and Dry sand Mould), Testing of moulding sand, Preparation of mould, various stages in casting processes. Different types of casting processes (Die, Centrifugal, Continuous, and investment casting). Gating and rising system design with numerical problems.

Pre-Requisite Courses (/ Papers):	Workshop Practice

Text books:	• Manufacturing Science-A. Ghosh and A.K. Malik, Affiliated East Press, New-Delhi.
Reference books:	• Campbell, J.S., Principles of Manufacturing Materials and Processes, McGraw-Hill, New-York, • De Garmo, E.P., Materials and Processes in Manufacturing, Collier Macmillan, New York. • Lindberg, R.A., Processes and Materials of Manufacturing, Allyn and Bacon, Boston, 1 • Schey, J.A., Introduction to Manufacturing Processes, McGraw-Hill, New-York.
Course Objective	To understand and analyse the major manufacturing processes including cutting, casting, joining and their supporting tools.
Course Outcomes	CO1: Understanding and classifying various operations and working principles of machine tools CO2: Advancing the knowledge of Lathe and Milling machines. CO3: Advancing on Drilling, Reaming and Broaching. CO4: Exploring various Welding processes and their characteristics. CO5: Boosting the basic knowledge of casting and its classifications.
Computer Usage / Software required:	e.g. MATLAB, SOLIDWORKS, CATIA, AutoCAD etc.
Other details regarding this course	Visit to manufacturing organization will help broaden the horizon.

APPLIED THERMODYNAMICS

Paper Code	**BM –303**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Review of basic concept of Thermodynamics, Law of conservation of energy and First law of Thermodynamics for a closed/open system undergoing a cycle; Steady flow energy equation, Second law of thermodynamics, Energy and entropy, Reversible and irreversible processes, Second law analysis; Psychrometric chart; Availability and irreversibility, Gibb's function, Helmholtz function, Clausius and Clayperon equation.

Unit-II

Thermodynamic cycles, Carnot Cycle, Stirling cycle, Ericsson cycle, Joule cycle, Air standard cycle, Otto cycle, Diesel cycle, Dual cycle, Rankine cycle, Modified Rankine cycle, working of steam power plant, Vapour Compression Refrigeration cycle, Binary vapour cycle.

Unit-III

Steam turbine, Types and application, Impulse and reaction turbine, compounding of impulse turbine, pressure and velocity diagrams, reaction turbines, Work output, Losses and efficiencies, Reaction turbine, velocity diagram, degree of reaction, work output, governing of turbine, Nozzles, isometric flow through nozzles, critical pressure, pressure ratio, maximum discharge, stagnation condition

Unit-IV

Condensers, types of condensers, jet and surface condensers, Compressors, Types, reciprocating, centrifugal, axial flow, single and multistage compressors, effect of inter-cooling, surging, choking and stalling

Unit-V

Boilers and its classification, I.C. Engines, types, Air fuel mixture requirement, normal/abnormal combustion in S.I. and C.I. Engines, Calculation of engine performance, requirement and suitability of fuels in I.C. Engines.

Pre-Requisite Courses (/ Papers):

- Thermodynamics

Text books:

- Applied Thermodynamics: P. K. Nag, Tata McGraw Hill Publications.

Reference books:

- Applied Thermodynamics Engineering technology by T. D. Eastop&McConkey, Pearson Education.
- Applied Thermodynamic Sciences. Principle Applications. S. K. Agrawal, Viva Book.

	• Turbine Compressors and Fans, S. M. Yahya, Mc-Graw Hill. • Thermal Engineering by R. K. Rajput, Laxmi Publication, Delhi.
Course Objective	This course is designed to teach mechanical engineering students the application of thermodynamic principles to the design and optimization of Thermal Engineering Systems. Specifically, students will be taught how to apply the laws of thermodynamics to vapour power and refrigeration systems, gas power systems, applications concerning humidification, dehumidification, evaporative cooling, and thermodynamics of combustion systems such as furnaces, flow reactors etc.
Course Outcomes	CO1: Able to understand the laws and limitation of thermodynamics and will be able to sort out realistic and unrealistic thermodynamic system claims. CO2: Able to analyse a vapour power cycle given a set of operational parameters and constraints, determine cycle efficiency, its power output, and required heat input. CO3: Able to understand cycle efficiency for the steam power cycle, gas turbine cycle. CO4: Able to analyse and optimize a vapour refrigeration system given the requirements and constraints of a refrigeration system. CO5: Able to analyse and determine cycle efficiency, work output and required heat input for a Petrol/Diesel engine with a given set of operating parameters.
Computer Usage / Software required:	Students can be introduced to basic simulation software such as FLUENT.
Other details regarding this course	This is a basic course necessary for further studies in Thermal Engineering and Sciences

MATERIAL SCIENCE

Paper Code	**BM –304**
Course Credits	**4**
No. of lectures/week	**3**
No. of Tutorials/week	1

Course Description

Unit – I

Introduction: Historical perspective, importance of materials. Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bondings. Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. Imperfections, Defects & Dislocations.

Unit-II

Mechanical properties and Testing: Stress strain diagram, Ductile & brittle material, Stress vs. strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testing such as Strength testing, Hardness testing, Impact testing, Fatigue testing Creep testing,Non-destructive testing (NDT)

Micro structural Exam: Microscope principle and methods. Preparation of samples and Microstructure exam and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass. Phase Diagram and Equilibrium Diagram: Uniary and Binary diagrams, Phase rules.Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram.

Unit – III

Ferrous materials: Brief introduction of iron and steel making furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses.

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and their applications. Various type Brass, Bronze, bearing materials, their properties and uses. Aluminum alloys such as Duralumin.

Unit –IV

Magnetic properties: Concept of magnetism – Dia, para, ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages. Electricproperties: Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. P-n junction and transistors.

Unit – V

Ceramics: Structure types and properties and applications of ceramics. Mechanical/Electrical behaviour and processing of Ceramics. Plastics: Various types of polymers/plastics and their

	applications. Mechanical behavior and processing of plastics. Future of plastics. Other materials: Brief description of other material such as optical and thermal materials concrete, Composite Materials, fibre, particle reinforced composites and their uses. Strength and stiffness based basic design principles of fibre reinforced composites. Brief introduction to Smart materials and Nano-materials and their potential applications. Performance of materials in service: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control.
Pre-Requisite Courses (/ Papers):	Physics and Chemistry.
Text books:	• W.D. Callister, Jr, – Material Science & Engineering Addition-Wesley Publication.
Reference books:	• Van Vlash – Elements of Material Science & Engineering John Wiley & Sons. • V. Raghvan – Material Science, Prentice Hall. • Narula – Material Science, TMH.
Course Objective	• To establish the basic structure/property relationships in materials through an exploration of bonding, crystalline structure, defects and diffusion phenomena. • To gain an understanding of properties, processing, and applications of metallic, ceramic, polymeric and electronic materials.
Course Learning Outcomes	CO1: Understanding the importance and basic chemistry behind materials along with crystallography and imperfections. CO2: Examining materials under various testing and their microstructural analysis. CO3: Developing the knowledge of ferrous and non-ferrous materials and their properties under heat treatment. CO4: Strengthening the concept of magnetism and energy band of various materials. CO5: Extending the study of materials to advance materials.
Other details regarding this course	This is a predominantly basic course and helps understand how to best use different material for design and manufacturing.

MECHATRONICS

Paper Code	**BM–305**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Introduction to Mechatronics: Origin& evolution of Mecha tronics. Objectives, Advantages, And Disadvantages of Mechatronics, System Interfacing, Instrumentation and Control Systems, open and cloosed Loop Systems, Sequential Systems.

Elements of Mechatronics: Sensors and Transducers, Timers. Ssignal Conditioning, Signal Nomenclature, Signal Processing. Digital Logic. Microprocessor-based Digital Control, Basic Elements of control systems, Microprocessor Architecture, Terminology, instruction Types, Addressing Models, Intel 8085A Microprocessor, Microcontrollers, Relayand Programmable Logic Controller.

Unit - II

Pneumatics & Electro Pneumatics: Introduction to Pneumatics.Air Compression, Distribution andTreatment. Directional Control valves. Electro Pneumatic Components. Circuit Design. Pneumatic Actuation System,Practical Exercises

Unit-III

Actuators and Mechanisms: Actuator Types and application Areas, Electromechanical Actuators, DC Motors, AC Motors, Fluid Power Actuators, Piezoelectric Actuators, Magnetostrictive Actuators, Memory-metal Actuator, Ion-Exchange Polymer-metal Composites, Chemical Actuator, Mechanisms, Bearings, Belt, Chain, Pulleys, Gears, Rack and Pinion, Ratchet, Pawl and Crank, Slider and Crank, Cams and Follower, Chain and Sprocket, Geneva Wheel, Four-bar Linkages.

Unit-IV

Modelling: Systems, Modelling, Mechanical System, Electrical Systems, Fluid Systems, Thermal Systems, Engineering System, Translational Mechanical System with spring, Damper and Mass. Rotational Mechanical Systems with Spring, Damper and Mass, Modelling Electric Motor, Modelling Chamber Filled with Fluid, Modelling Pneumatic Actuator.

Unit-V

Intelligent Systems and Their Applications- Advance Actuators, Consumer Mechatronics Products, Hydraulic Fingers, Surgical Equipment, Industrial Robot, Autonomous Guided Vehicle (AGV),Drilling Machine, Conveyor-based Material Handling Systems.

Mechatronics in Manufacturing

Production Unit, Input/output and Challenges in Mechatronics Production Units, Knowledge Required For Mechatronics in Manufacturing, Main Features of Mechatronics in Manufacturing, Computer Integrated Manufacturing, just- in-Time Production Systems, Mechatronics and Allied Systems.

Pre-Requisite Courses (/ Papers):	Theory of Machines, Manufacturing Process, Basic Electrical & Electronics Engineering, Instrumentation and Control.
Textbooks:	• W. Bolton, 'Mechatronics', Pearson Education New Delhi... • N P Mahalik Mechatronics Principle, concept & Application, Tata McGraw-Hill, New Delhi
Reference books:	• Robert H. Bishop, 'Mechatronics Hand Book', CRC Press, New York • J.R Groot, 'Introduction to Pneumatics', Fluid Power Education Foundation, Milwaukee.
Course Objective	The Objective of this course is to impart the skills and knowledge that are not confined to a single subject area, but a range of engineering disciplines. Students completing a course will be capable of working in a number of interesting areas i.e. process engineering, product design, manufacturing, automation, quality and business process, green engineering and research and development.
Course Outcomes	CO1: Introduction to Mechatronics and understanding its origin, evolution and future aspects. CO2: Plan for sustainable and effective solutions through the application of mathematics, science and engineering fundamentals to study Pneumatics. CO3: Advancing the knowledge of different types of actuators and deriving various related mechanisms. CO4: Present technical and scientific findings effectively by using sophisticated modelling techniques. CO5: Introduction to modern machinery and intelligent systems used in industries.
Computer Usage / Software required:	MATLAB, EP-I.

Course Structure DescriptionB.Tech.(Mechanical Engineering)

FOURTH Semester

HEAT AND MASS TRANSFER

Paper Code	**BM-401**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Modes of Heat Transfer: Transfer of One dimensional, Heat Conduction, Resistance Concept, Electrical Analogy.

Fourier's Law of Conduction, Thermal Conductivity of Solids, Liquids and Gases, General Conduction Equation in Cartesian Coordinates and Cylindrical Coordinates, One Dimensional steady heat flow through plane wall cylinders and spheres, Heat flow through composite wall, cylinder and sphere, critical thickness of insulation. Different type of fins. Heat transfer from fin of uniform cross-section, Two-dimensional conduction through plane walls.

Unit-II

Convection: Free and forced convection, hydrodynamics and thermal boundary layers, similarity conditions of Heat Transfer Process. Equation of Momentum and Energy, Application of dimensional analysis, Empirical equation of convection Heat Transfer, condensation heat transfer, Drop-wise and film wise condensation; Laminar film on a vertical surface.

Unit-III

Boiling Heat Transfer, Pool boiling regimes, Heat Exchangers, Classification of Heat Exchange Overall Heat Transfer Coefficient, LMTD method for parallel flow & counter flow, The NTU method. Pressure Drop.

Unit-IV

Radiation: Black body radiation, Definitions, Emissive Power, Emissivity. Absorptive, Reflectivity and Transmissivity, Black, Gray, White & real Surfaces, Planck's Distribution law, Kirchoff's law, Wien's Displacement Law, Stefan Boltzman Law, Radiation Shape factor.

UNIT-V

Mass Transfer: Analogy between Mass Transfer and Heat Transfer, The conservation of Chemical Species, diffusion Mass Flux, Fick's Law, diffusion Molar Concentration and Flux, diffusion through a stationary medium, steady state diffusion through a plane membrane.

Reference Mass Coefficient, Convective Mass Transfer, Boundary Layer Concentration, Governing equations.

Pre-Requisite Courses (/ Papers):

- Thermodynamics, Applied Thermodynamics

Text books:

- Fundamentals of Engineering Heat and Mass Transfer, by R.C. Sachdeva, New Age International Publisher.

Reference books:	• Fundamentals of Momentum, Heat and Mass Transfer, by James R. Welly, Chark E. Wicks and Robert E. Wilson, & Sons. • Principles of Heat Transfer, by, Frank P. Kreith and Mark S. Bhonharpar& Row Publisher. • Basic Heat and Mass Transfer, by A.F. Mills, Prentice Hall of India. • Heat and Mass Transfer, A P. Singh, Macmillan India Ltd. • Fundamental of Heat and Mass Transfer, C.P. Kothandaraman, New Age international Publisher. • Heat transfer principles & application, B.K. Dutta
Course Objective	• Students will understand the basic concepts of conduction, convection and radiation heat transfer. • Students will understand how to formulate and be able to solve one and two-dimensional conduction heat transfer problems. Solution techniques will include both closed form and numerical methods. Convection effects will be included as boundary conditions. • Students will understand the fundamentals of the relationship between fluid flow, convection heat transfer and mass transfer. • Students will apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient. They will then calculate heat transfer rates using the coefficients. • Students will understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation. • Students will be able to evaluate radiation view factors using tables and the view factor relationships.
Course Outcomes	CO1: Basic concepts of conduction, convection and radiation heat transfer. Formulate and solve one and two-dimensional conduction heat transfer problems. CO2: Widening the concepts of convection and solving problems related to its applications. CO3: Fundamentals of heat exchangers and its analysis using LMTD and NTU methods. CO4: Strengthening the basics of radiation and understanding the related laws. CO5: Understanding mass transfer using analogy with heat transfer.
Computer Usage / Software required:	Students can be introduced to basic simulation and modelling software.

FLUID MECHANICS-I

Paper Code	**BM-402**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Introduction: Definition and properties of fluids (as distinct from solids), Units and dimensions, Classification of fluids, Normal and shear stresses in fluids.
Fluid Statics: Pressure at a point, Basic equation of fluid statics, Manometry, Hydrostatic forces on submerged surfaces, Buoyancy and stability, Stability of floating bodies, Fluids in rigid-body motion.

Unit-II

Kinematics of Fluid Flow: Types of motion, Streamlines, Pathlines and streaklines, Velocity and rotation, Stream function, Acceleration of fluid particle, Vorticity and circulation, Irrotational flow, Velocity potential function, Differential equation of conservation of mass, Standard irrotational flows and superposition.

Unit-III

Dynamics of Ideal Fluid Flow: Euler's equation of motion, Bernoulli's equation and its applications, Bernoulli's equation applied to irrotational flow, Flow measuring devices, Venturi-meter, Orifice-meter and Nozzle-meter, Pitot-static tube, Hydraulic coefficients, Flow through pipes, Major and minor losses in pipe flow, Power transmission by a pipeline.

Unit-IV

The Integral Analysis of Flow: System and Control volume approaches, Basic laws for a system, Relation of system derivatives to the control volume formulation, The Transport Theorem, Integral form of Basic laws; Conservation of mass, Linear momentum equation, Moment of momentum equation, Energy equation and their applications.

Unit -V

Flows with a Free Surface: Flow over notches and weirs.
Open-Channel Flow; The Chezy's formula, Efficient uniform-flow channels, Specific energy, critical depth, Hydraulic jump, Gradually varied flow.

Pre-Requisite Courses (/Paper): The prerequisites for this course are: vector algebra and calculus, differential equations, particle and rigid body dynamics and thermodynamics.

Text books:

- Introduction to Fluid Mechanics by R.W. Fox and A.T. McDonald, John-Wiley and Sons.

Reference books:	• Fluid Mechanics by F.M. White, McGraw-Hill. • Introduction to Fluid Mechanics and Fluid Machines by S. K. Som and G. Biswas, Tata McGraw –Hill Pub. Company Ltd. • Fluid Mechanics and Its Applications by Vijay Gupta and S.K. Gupta, New Age International Pub. • Foundations of Fluid Mechanics by S.W. Yuan, Prentice Hall. • Fluid Mechanics by P. K. Kundu and I. M. Cohen, Academic Press, Elsevier.
Course Objective	Knowledge and understanding of the basic principles and concepts of fluid mechanics are essential to analyse any system in which a fluid is the working medium. The design of all means of transportation requires application of the principles of fluid mechanics. In recent years Vehicle manufacturers have given more consideration to aerodynamic design. The design of propulsion systems for space flight is based on the principles of fluid mechanics. It is commonplace today to perform model studies to determine the aerodynamic forces on, and flow fields around, buildings and structures.
Course Outcomes	CO1: Definition and properties of fluids (as distinct from solids), Units and dimensions, Classification of fluids, Fluid Statics. CO2: Kinematics of Fluid, Vorticity and circulationDifferential equation of conservation of mass. CO3: Dynamics of Ideal Fluid Flow: Euler's equation of motion, Bernoulli's equation and its applications,Flow measuring devices, Major and minor losses in pipe flow, Power transmission by a pipeline. CO4: The Integral Analysis of Flow, The Transport Theorem, Moment of momentum equation, Energy equation and their applications. CO5: Understanding the knowledge of various flows on the free surface.
Computer Usage / Software required:	e.g. MATLAB, EXCEL, EES etc.
Other details regarding this course	This is a basic course on fluid mechanics

PRODUCTION ENGINEERING-I

Paper Code	**BM-403**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Metal cutting, Geometry of metal cutting tools: Nomenclature of cutting tools, Introduction, system of cutting tool nomenclature, new International standard. Geometry of drills. Geometry of face milling cutter, Geometry of plane milling cutters. Chip Control:
Introduction. Chip breakers, Prediction of Radius of Chip Curvature, Tools, Tool wear during chip breaking, Machine tool, Vibrations -chatter.

Unit-II

Mechanics of Metal Cutting: Introduction, Terms and definitions, chip formation, forces acting on the cutting tool and their measurement, specific cutting energy, Ploughing force and the "size effects", Apparent mean shear strength of the work material, Ship thickness, (Merchant diagram), Friction in metal cutting. Thick chip machining.

Unit-III

Temperatures in metal cutting: heat generation in metal cutting Heat transfer in a moving material, Temperature distribution in metal cutting Measurement of cutting temperatures. Tool life and Tool wear Introduction, progressive tool wear, Forms of wear in metal cutting, Tool material, work material. Cutting fluids and surface Roughness cutting fluids. Action of coolants. Action of Lubricants. Surface Roughness.

Unit-IV

Theory of metal forming: Fundamentals of theory of plasticity. Friction in metalworking. Frictionless wire drawing. Wire drawing with friction and back pull. Rolling.

Unit-V

Extrusion, sheet metal forming: Deep Drawing, Blanking Punching. Forging, open and close die forging, smith press, drop and machine forging, calculation of forging force.

Pre-Requisite Courses (/ Papers): Material Science, Manufacturing Processes, Workshop Practice-I & II

Text books: Manufacturing Science, by Malik A and Ghosh, Affiliated East- West Press Pvt., Ltd.

Reference books:

- Fundamentals of Metal Machining and Machine Tools, by Geoffrey Boothroyd, McGraw-Hill International Book Co.
- Fundamentals of Tools Design by Wilson, Prentice Hall.
- Manufacturing Technology by John R. Lindbergh Molly W. Williams and Robert M. Wygant.

	• Technician Manufacturing Technology by M. Hazlehurst (English Language Book Society). • Introduction to the theory of Plasticity for Engineers by Hoffman and George Sachs McGraw-Hill.
Course Objective	• To demonstrate the fundamentals of machining processes and machine tools. • To develop knowledge and importance of metal cutting parameters. • To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms. • To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes. • To develop fundamental knowledge on metal forming processes.
Course Outcomes	CO1: To develop fundamental concepts of machining, cutting tools, and quality parameters of machining parts. CO2: To investigate and relate effects of machining process parameters with the practical machining applications. CO3: To estimate and prescribe machining condition to machining factors for machine capacity and preventing forces, temperature and power. CO4: To develop fundamental concepts of various metal forming processes CO5: To prescribe involved forces and power for real life situation of metal formed products.
Computer Usage / Software required:	
Other details regarding this course	This course is predominantly important for manufacturing Industry visit will help.

CAD AND FEM

Paper Code	**BM-404**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit -I

Introduction: Definition of CAD/CAM, Industrial Look at CAD/CAM, CAD/CAM System Evaluation Criteria, CAD/CAM Input/output devices. Basic Definitions, Software Module, CAD/CAM Software.

Geometric transformations: Introduction, Transformation of Geometric Models, Translation, Scaling, Reflection, Rotation, Homogeneous Representation, Concatenated Transformation.

Unit-II

Wire frame Modeling: Introduction, Wire-frame Model, Wire-frame Entities, Curve Representation, Parametric Representation of Analytic curves- Line, Circle, and Ellipse. Parametric Representation of Synthetic curves-Hermite Cubic Spline, Beziercurve, B-Spline curve

Surface Modeling: Introduction, Surface Models, Surface Entities, Surface Representation. Parametric Representation of Analytic Surface-Plane Surface Ruled Surface, Surface of revolution. Parametric Representation of Synthetic Surface-HermiteBicubic Surface, BezierSurface, B-Spline Surface

Unit -III

Solid Modeling: Introduction, Solid Models, Solid Entities, Boundary Representation-Introduction, Basic elements, Euler Equation Application. Constructive Solid Geometry-Introduction, CSG Tree. Sweep Representation-Introduction to Linear, Non Linear & Hybrid Sweep.

Visual Realism & CAD data exchange files: Introduction to Model-Cleanup, Hidden line and surface removal, Shading & colouring Models. Evolution of Data Exchange formats, Shape-Based Format, Product Data Based Format, ISO Standards-IGES

Unit-IV

Introduction of FEM& Concepts: Basic steps in FEM. Elements, nodes and degree of freedom. Element characteristic matrix. Different methods to derive an element characteristic matrix. Direct method to develop element stiffness matrix. Types of elements, one-dimensional elements, two-dimensional elements and their classification. Three-dimensional elements. Related problems. Isoparametric concepts. Shape functions of one dimensional element, Linear, Quadratic, cubic and quadric bar elements, shape functions of two-dimensional elements (Lagrangian and Serendipity family), shape functions of triangular elements, Derivative of shape. functions, Jacobian matrix [J]

UNIT-V

Analysis of Plane Truss and Heat Transfer Using FEML: Solution of the plane truss, Deriving element stiffness matrix (Truss Element) [k], Global stiffness matrix

	[K] and its physical meaning, Properties of [K] matrix. Solution of unknowns. Simple problem of truss having 3 bars, Potential energy approach, One dimensional problem in stress analysis and heat transfer
Pre-Requisite Courses (/ Papers):	Mathematical background through ordinary differential equations, Matrix & Vector algebra. Engineering Graphics computer.
Text books:	• Ibrahim. Zeid, "CAD/CAM: Theory and Practice", TMH. • Rogers D. F. and J. A. Adams, "Mathematical Elements of Computer Graphics", McGraw-Hill, New York
Reference books:	• Beasant C. B. and Lui C. W. K. "Computer Aided Design and Manufacturing", 3rd Edition, Affiliated East West Press Ltd., New Delhi. • Mortenson M. E., "Geometric Modeling", John Wiley, New York.
Course Objective	Computers play an important role in Engineering design and analysis. This course gives an overview of analytical treatment on of the use of computers in design and analysis to increase the overall performance of the system
Course Outcomes	CO1: Fundamental principles on hardware and software requirements in CAD/CAM. CO2: Design and drafting of simple and complex machine parts using CAD through wireframe and surface modelling. CO3: Fundamental knowledge in visualising parts using solid modelling. CO4: Building the basic concepts of FEM and understanding its various characteristics. CO5: Analysis of plane Truss and Heat transfer using FEM.
Computer Usage / Software required:	ANSYS, SOLID WORKS, CATIA, Pro/E and other CAD/FEM software
Other details regarding this course	This needs extensive practice with available software used in industry

INSTRUMENTATION, MEASUREMENT AND CONTROL

Paper Code	**BM – 405**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1
Course Description	**Unit- I** General Concepts: Measurement, Instrumentation, significance, standards, Methods, Methods and Modes of Measurement. Instruments-Classification and functional elements of a Measurement System. Static performance characteristics-Errors and Uncertainties, Propagation of Uncertainties, Performance Parameters, Impedance. Loading and Matching. Graphical representation and curve fitting of Data- Equations of Approximating curves. Determination of Parameters in linear relationship. Method of Least square and linear least square curve fitting. Related Numerical problems. **Unit -II** Dynamic characteristics of Instruments-Dynamic Inputs, Formulation of system equations, Dynamic Response. Transducer Elements. Intermediate Elements-Amplifiers, A-D and D-A converters, filters, Terminology and conversions, Data Transmission Elements, Related Numerical Problems **Unit -III** Measurements, Methods and Applications- Force Measurement, Torque and Power Measurements, Presume Measurement (High Pressure Moderate and vacuum) Related Numerical Problems. **Unit-IV** Temperature Measurement: - Non-electrical, electrical and Radiation Methods of Temperature Measurement. Flow measurement-Primary, Secondary and special Methods of flow Measurement, Measurement of liquid Level, Biometrics and Air pollution parameters. Related Numerical Problems. **Unit- V** Control Engineering–Classification, Applications of control Engineering, Feedback control system with their block diagrams, Transfer functions of elements, systems and processes. Transient and Steady State Response of control systems, stability of control systems. Related Numerical Problems.
Pre-Requisite Courses (/ Papers):	Basic courses of Physics, Electronics and Electrical Engineering
Text books:	• Measurement Systems by Ernest O. Doebelim, Tata McGraw Hill Publication. • Instrumentation, Measurement and Analysis by Nakra and Choudhary, Tata McGraw Hill Publication.
Reference books:	• Mechanical Measurement by Beckwith and Buck, Oxford and IBH. • Instrumentation for Engineering Measurement by Dally, William and Mc

	Connell, John Wiley and Sons.
Course Objective	• To provide knowledge of Measurable quantities, their detection, acquisition, control and analysis of measurement data this is important phenomena in almost all areas of Science Engineering and Technology. • To be aware with instrument characteristics, the measurement principles, methods, constructional feature, advantages and limitations of the instruments. • To study control engineering, small and compact type control systems, their working principles and applications.
Course Outcomes	CO1: Recognise the instrument systems, their principles, methods of measuring different physical variables and analysis of data. CO2: Formulation of system equations and extending the knowledge of dynamic inputs and response. CO3: Solve problems related to measurement of Force, Torque, Power and Pressure. CO4: Acquire knowledge of recent developments in instrumentation and measurement of Temperature. CO5: Recognise the control engineering, their types, different systems and processes, their applications in Industries and House hold appliances
Computer Usage / Software required:	ANSYS, Excel, MATLAB and similar software, Lab view
Other details regarding this course	This course is of predominant importance for machine control integrating mechanical systems and futuristic development.

NUMERIC AND SCIENTIFIC COMPUTING

Paper Code	**BM - 406**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorial/week	1

Course Description

Unit –I

Interpolation withEqual and Unequal Intervals of the Arguments:
Newton-Gregory, Gauss, Stirling and Bessel Formulae, Aitken & cubic spline interpolation methods for equal intervals; Newton's divided difference and Lagrange's formulae for unequal intervals; Inverse interpolation using Lagrange's formula, method of successive approximations and double, triple interpolation.

Unit -II

NumericalDifferentiation and Numerical Integration**:**
Numerical successive differentiation using forward, backward, central differences interpolation formulae, Lagrange's and Newton's divided difference interpolation formula. Numerical integration using Simpson's 3/8 rule, Boole's rule, Weddle's rule, Romberg integration, Gauss-Legendre, Lobatto, Radau and Guass–Chebyshev rules. Errors in Quadrature formulae and numerical double integration.

Unit- III

NumericalSolutionsofAlgebraicandTranscendental Equations:
Bisection, Regula- False position, Newton-Raphson, Graeffe's root-squaring methods for the solution of non-linear algebraic & transcendental equations involving one variable, rate of convergence and error analysis of the methods, Newton-Raphson method for the solution of a system of non-linear equations of two and three variables.

Unit- IV

Numerical Solution of a System of Simultaneous Linear Equations and Curve Fitting**:**
Gauss elimination & Gauss-Jordan methods, Ill conditioned linear system, Gauss-Seidel and Crout methods for the solution of a system of linear equations in four unknowns; General curve (linear, quadratic, exponential and other non-linear functions) fitting using method of least squares.

Unit -V

Numerical Solutions of Initial and Boundary Value Problems:
Numerical approximate solutions of a system of simultaneous and higher order ordinary differential equations using Taylor's series method, Picard's method and Runge-Kutta fourth order method; Runge-Kutta- Fehlberg method, Euler's modified and Milne's methods; Numerical solution of boundary value problems using finite difference method, shooting method and cubic spline method.

Pre-Requisite Courses (/ Papers):	Engineering Mathematics-I, II &IIT Objective Mathematics and handling the Scientific Calculator

Text books:	• Numerical methods for Scientific and Engineering Computation, M.K. Jain, S.R.K. Iyengar& R. K. Jain, New Age International (P) Ltd. • Introductory Methods of Numerical Analysis, Sastry, S S, Prentice Hall of India Pvt. Ltd.
Reference books:	• Numerical Methods for Engineers Steven C. Chapra& Raymond P. Canale,Tata McGraw Hill Book Co. • Computer Oriented Numerical Methods,Rajaraman; V, Prentice Hall of India Pvt. Ltd. • Elements of numerical analysis, Radhey S. Gupta, Macmillan India Ltd.
Course Objective	To understand basic Mathematics for solving Engineering Problems
Course Outcomes	Students will be able to understand computer orientated numerical methods as given below: CO1- Interpolation with Equal and Unequal Intervals of the Arguments CO2- Numerical Differentiation and Numerical Integration CO3- Numerical Solutions of Algebraic and Transcendental Equations CO4- Numerical Solution of a System of Simultaneous Linear Equations and Curve Fitting CO5- Numerical Solutions of Initial and Boundary Value Problems
Computer Usage / Software required:	MATLAB, EXCEL, MAXIMA, MATHEMATICA etc.
Other details regarding this course	Problem solving will enable students to solve Mechanical Engineering Problems.

Course Structure Description

B.Tech.(Mechanical Engineering)

FIFTH Semester

KINEMATICS OF MACHINES

Paper Code	**BM –501**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-1

Basic Concept of Mechanisms and Machines: Link, kinematic pairs and their classifications. Kinematic chain, Mechanism and their inversions. D.O F of a mechanism. Motion and its types. Four bar chain and its inversions. Slider-crank chain. Double slider crank chain. Compound kinetic chain. Quick return motion mechanisms. Mobility of four bar linkage (Grashof's criterion) Mechanisms with lower pairs.

Unit-II

Velocity and Acceleration Analysis in Mechanisms: Analytical method for velocity and acceleration of a mechanism. Relative velocity and instantaneous center method for determination of velocities of links of a mechanism. Velocity and acceleration diagrams for different mechanisms. Klein's construction for a reciprocating engine. Coriolis component of acceleration.

Unit-III

Kinematic Synthesis of Plane Mechanism: Types of Kinematic Synthesis, Type, dimensional, number synthesis, function generation, path generation & motion generation.

Analytical Method of Dimensional Synthesis

Four bar, slider crank function generator with three accuracy points, method for complex variables, four bar linkage for specified instantaneous condition using Freudenstein's Equation. Bloch's synthesis, Graphical Methods.

Unit-IV

Gears: Motion transmitted by two-curved surface in contact. Gear nomenclature. Types of teeth. Interference and undercutting. Minimum number of teeth on gear wheel/pinion to avoid interference. Arc and path of contact in the case of straight tooth spur gears. Introduction to helical and bevel gears.

Unit-V

Gear Trains: Types of gear trains. Epicyclic and compound gear trains for change in speed. Torques and tooth loads in epicyclic gear trains.

Friction: Friction in square threaded screw, Collars and pivots: Power transmitted through friction in belts, ropes and clutches. Friction axis of a link and friction axis of a connecting rod in the slider-crank mechanism. Effect of friction in slider-crank mechanism.

Pre-Requisite Courses (/ Papers):	Mechanics of solid, Mathematical differentiation and integration
Text books:	• Theory of Mechanisms and Machines by Dr.JagdishLal, Metropolitan Book, Co. Pvt. Ltd.,

Reference books:	• The Theory of machines by Thomas Bevan, CBS Publishers anddistributors • Theory of Machines and Mechanisms by J. E. Shigley and J. J. VickerMcGraw Hill Book co. • Mechanisms and Machine theory by J.S. Rao and R.Y. Dukkipati, Wiley Eastern Ltd. • Design of Mechanics by Robert L Norton, McGraw-Hill Publishing Co.
Course Objective	• Identify mechanisms and predict their motion • Calculate the degrees of freedom of mechanisms • Design mechanisms to fulfil motion generation and quick return requirements. • Determine the positions, velocities and accelerations of • links and points on mechanisms • Derive SVAJ functions to fulfil cam design specifications • Calculate dynamic joint forces of mechanisms • Balance simple rotating objects and pin-jointed four barlinkages • Use related computer programs to design, model and analyse mechanisms
Course Outcomes	CO1: Building concepts of mechanism and machines. CO2: Analysis of velocity and acceleration in mechanisms. CO3: Understanding the kinematic synthesis of plane mechanisms. CO4: Developing the knowledge of gears and understanding the motion transmitted by two curved surfaces in contact. CO5: Building the basic knowledge of gear trains and friction in various mechanisms.
Computer Usage / Software required:	Simulation Softwareare required to be learned.
Other details regarding this course	This is a basic course for Machine Dynamics.

FLUID MECHANICS-II

Paper Code	**BM-502**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Dimensional Analysis and Similitude: Nature of dimensional analysis, Principle of dimensional homogeneity, Buckingham's Π theorem, determining the Π groups, Significant dimensionless groups in FM, Flow similarity and model studies.

Unit-II

Laminar flow: Differential analysis of fluid flow: Governing equations, Continuity eq., Conservation of linear momentum in differential form, Navier-Stokes (N-S) equations; exact solutions of N-S equations, Low Reynolds number flows.

Unit-III

Turbulent flow: Fundamentals of turbulent flows: Reynolds experiment, time mean and time dependent description, Reynolds stress tensor, Phenomenological theories of turbulence, Prandtl mixing-length and eddy viscosity concepts, Turbulent flow in pipes, Smooth and rough pipes, Drag reduction in pipes.

Unit-IV

Boundary layer theory: Boundary layer theory: Boundary layer thickness, displacement thickness, momentum thickness, Prandtl's boundary layer equations, Laminar boundary layer over a flat plate, von-Karman momentum integral eq., Laws of drag over flat plate, Effect of pressure gradient, Boundary layer control.
Flow around immersed bodies:
Drag force, lift and drag coefficients, streamlined and bluff bodies, drag on circular cylinder and sphere, drag and lift on an aerofoil, circulation and lift on circular cylinder and on aerofoil.

Unit-V

Compressible flow: Thermodynamic relations, basic eqns. of compressible flow, propagation of pressure waves, stagnation properties, Isentropic flow through with area changes, Critical properties, Normal and oblique shock waves, Rayleigh and Fanno flows.

Pre-Requisite Courses (/ Papers): Fluid Mechanics-I

Text books:

- Fluid Mechanics by F.M. White, McGraw-Hill.

Reference books:

- Introduction to Fluid Mechanics by R.W. Fox and A.T. McDonald, John-Wiley and Sons.
- Introduction to Fluid Mechanics and Fluid Machines by S. K. Som and G. Biswas, Tata McGraw –Hill Pub. Company Ltd.
- Fluid Mechanics and Its Applications by Vijay Gupta and S.K. Gupta, New

	Age International Pub. • Foundations of Fluid Mechanics by S.W. Yuan, Prentice Hall. • Fluid Mechanics by P. K. Kundu and I. M. Cohen, Academic Press, ELSEVIER.
Course Objective	• Knowledge and understanding of the basic principles and concepts of fluid mechanics are essential to analyse any system in which a fluid is the working medium. • The design of all means of transportation requires application of the principles of fluid mechanics. In recent years automobile manufacturers have given more consideration to aerodynamic design. • The design of propulsion systems for space flight is based on the principles of fluid mechanics. • It is commonplace today to perform model studies to determine the aerodynamic forces on, and flow fields around, buildings and structures.
Course Outcomes	CO1: Knowledge and understanding of dimensional analysis and similitude. CO2: Understanding the laminar flow and governing the differential analysis and its continuity equation. CO3:Developing the fundamentals of turbulent flow and studying phenomenological theories of turbulence. CO4: Analysis of boundary layer theory and flow around immersed bodies. CO5: Understanding the thermodynamic relation and basic equations of compressible flow
Computer Usage / Software required:	e.g. MATLAB, EXCEL, EES etc.

DESIGN OF MECHANICAL COMPONENTS

Paper Code	**BM-503**
Course Credits	**4**
No. of Lectures/ week	3
No. of Tutorials/week	1

Course Description

Unit-I

Introduction: Introduction to Design Process & Phases of design. Design factors. Margin of safety. Working stresses. Theories of Failure. Types of joints. Types of riveted joints. Design of riveted joints. Design of welded joints. Eccentrically loaded riveted and welded joint. Cotter and Knuckle joint design.

Unit-II

Design against Fatigue: Fatigue strength. Factors affecting fatigue behaviour. Influence of superimposed static stress. Stress concentration. Notch sensitivity. Factor of safety. Practical measures to combat fatigue.

Unit-III

Screws: Design of screw joints under tension and shear, initial loading, consideration of stiffness. Eccentrically loaded screws joints. Standard threads. Power Transmission by screws. Friction and efficiency. Examples of application: screw jack, C-Clamp, lead screw, broach actuator etc. Design of nut-screw pair for axial load and torque. Impact load on bolts.

Unit-IV

Clutches and Brakes: Function of Clutches, Friction and limiting torque. Theories of uniform pressure and wear. Classification-single & multiple plate clutches. Cone clutch. Centrifugal Clutch. Energy loss during clutching. Consideration of heat dissipation in brakes and clutches. Description of power controlled clutches.
Brakes-function, types, lining material, Band, Shoe, Band and Shoe. Actuating mechanism. Maximum and average pressure. Leading and trailing shoe brakes. Disc Brakes.

Unit-V

Springs: Types of close and open coil Helical springs. Tension & compression spring. Design of helical spring. Combination in series and parallel. Leaf springs and design of leaf spring. Load on the clip bolts. Flat spiral springs. Material for springs. Method of improvement of life and strength.
Pressure Vessels
Thin cylinders, Thick cylinders, Lames Equation, Compound cylinders, Spherical Vessels.

Pre-Requisite Courses (/ Papers): Machine Drawing, Mechanics of solid and Engineering Materials

Text books:

- Mechanical Engg. Design by J.E. Shigley, C.R. Mischke
- Bhandari V B McGraw HI Book Co.

Reference books:	• Fundamentals of Machine Component Design by R.C. Juvinall, John Wiley & Sons • Design of Machine Elements by Spots, Prentice Hall of India. • Fundamentals of Mechanical Component Design by Edwards and McKee, McGraw-Hill. • Machine Design by Robert L. Norton, Prentice Hall, USA
Course Objective	To prepare a student of mechanical engineering to apply theory and practice of Design of Mechanical Elements. It is an introductory course laying foundation on design fundamentals, application of strength of material principles, selection of components and selection of materials for a given application. The objective also includes working with CATIA and other design software.
Course Outcomes	CO1: Detailed analysis of shaft and various factors for fatigue. CO2: Detailed study of bearings and their industrial uses. CO3: Understanding the concept of various types of power transmission system. CO4: Complete analysis of gears and its designing. CO5: Design of Gear Drives, Materials for gears standards for spur gears. Lubrication & efficiency of a gear drive.
Computer Usage / Software required:	Language- C, C++ Solid works, Pro/E, CATIA,ANSYS
Other details regarding this course	Machine Design practice with the help is necessary.

ENGINEERING ECONOMY

Paper Code	**BM-504**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1
Course Description	**Unit-I** Introduction to Engineering Economy: Definition, the economic environment, methodology and application. Principles of Engineering Economy. Steps in engineering economic analysis. Cost concepts and its application to break-even analysis. Basics of Demand, Supply and Equilibrium. Price Elasticity of Demand, Income Elasticity of Demand, Cross elasticity of demand, Market structure, Perfect competition, Monopoly, Monopolistic competition and Oligopoly. **Unit-II** Demand Estimation and Forecasting: Basic categories of forecasting method. Extrapolative methods, simple average, moving average and exponential smoothing. Errors involved in forecast. Explanatory methods, regression analysis for linear forecaster, coefficient of determination and coefficient of correlation. Qualitative method, Delphi approach, Market survey. **Unit-III** Interest and money-time relationship: Simple and compound interest, notation and cash flow diagram, the concept of equivalence. Interests formulas for discrete compounding and discrete cash flows relating present and future worth of single cash flows and uniform series (annuity), deferred annuities, annuities with beginning of period cash flows, equivalent present worth, future worth and annual worth. Interest formulas relating an arithmetic gradient series to its present and annual worth. Nominal and effective interest rates, interest problems with uniform cash flows occurring less often and more often than compounding periods. Increasing and decreasing gradients. **Unit-IV** Basic methods of making economic studies: Present worth, annual worth, future worth, internal rate of return, external rate of return, explicit reinvestment rate of return. Selection among alternatives: alternatives having identical (or not known) revenues and lives, alternatives having identical revenues and different lives, selection among independent alternatives. **Unit-V** Economic Evaluation of Public Sector Projects: Public sector projects, Benefit/Cost analysis of a single project, Selection between two mutually exclusive alternatives using incremental B/C analysis, Selection among multiple mutually exclusive alternatives using incremental B/C analysis. Depreciation and depletion: Definition and purpose, types of depreciation, capital recovery and depreciation methods Depletion methods.

Pre-Requisite Courses (/ Papers):	Basic Mathematics
Text books:	Engineering Economy, Zahid A. Khan, Arshad Noor Siddiquee, Brajesh Kumar. Pearson Education, New Delhi, India.
Reference books:	Engineering Economy, Degarmo E. Paul, Sullivan William G. And Bontadelli James A. Macmillan Co. of Singapore. Engineering Economy, Leyland Blank T. and Tarquin Anthony J. (1989), McGraw Hill Publishing Company Ltd., India. Engineering Economics, Panneerselvam R. Prentice Hall of India.
Course Objective	• To explain the basic principles of engineering economy and analysis tools relevant to engineering/business projects so as to take economically sound decisions. • To acquaint engineering students with different demand forecasting methods. • To provide engineering students with an appreciation and understanding of the time value of money and its importance in making engineering decisions. • To develop skills to use tools for economic analysis of both business projects and public-sector projects. • To acquire and independently apply concepts and techniques of economic analysis used to form engineering decisions.
Course Outcomes	CO1: Understand the fundamentals concepts and basic principles of engineering economy. CO2: Learn the various methods of demand forecasting. CO3: Draw the cash flow diagram (CFD) and compute equivalent values for time based cash flows of varying complexities. CO4: Understand and apply basic methods of making economy studies to assess economic feasibility of alternatives. CO5: Understand and compute depreciations of physical assets and also to learn basic methods for economic evaluation of public sector projects.
Computer Usage / Software required:	MS. EXCEL etc.

ELECTROMECHANICAL ENERGY CONVERSION

Paper Code	**BTM-505**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit - I

Three Phase Induction Motor: Construction, Principle of operation, torque-slip characteristics, relation between slip and speed, losses, speed control.

Unit - II

Synchronous Generator: Principle of operation, emf equation, voltage regulation by synchronous impedance method, efficiency.
Synchronous Motor: Principle of operation, effect of excitation, V-curves.

Unit - III

Single phase induction motor, Stepper motor, Switch reluctance motor, PMMC motor their characteristic and control.
Standard voltages used in generation, transmission. Generating station, sub-station: equipment and layout.

Unit - IV

Switchgear, relays, timers: their types, Introduction to PLC, ADC (Analog to digital converter), DAC (Digital to Analog converter).

Unit - V

Power Electronics and application: Characteristics of SCR, Turn ON-Off methods, rectifier, inverter, chopper, AC voltage controller, speed control of ac and dc motor.

Pre-Requisite Courses (/ Papers): Elements of Electrical and Electronics Engineering.

Text books:

- Robert Boylested, Louis Nashelky, "Electronic Devices and Circuit Theory" Sixth Edition, Prentice Hall of India Pvt. Ltd. New Delhi, India.

Reference books:

- Electric Machinery Fundamentals, Stephen J. Chapman, McGraw Hill Book Co.
- Digital Circuits and Logic Design, Morris Manno, Prentice Hall of India Pvt. Ltd., New Delhi.
- Electrical Machines, NagrathI.J. and D.P. Kothari, Tata McGraw Hill, New Delhi.
- Introduction to Power Electronics Rashid, M. H, Prentice Hall, India, New Delhi.

Course Objective To transfer the basic knowledge of electrical engineering to the students of Mechanical engineering, and also for allied Mechanical Engineering. Jobs

Course Outcomes	CO1: Understanding the concepts principles and operation of three phase induction motor CO2: Learning the working, principle and characteristics of synchronous motor and generator CO3: Expanding the knowledge of various types of motors and their characteristics CO4: Principle and design of switchgear and their types. CO5: Basics of power electronic and its application
Computer Usage / Software required:	MATLAB, etc.

Course Structure Description

B.Tech.(Mechanical Engineering)

SIXTH Semester

COMPUTER AIDED MANUFACTURING

Paper Code	**BM- 601**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/ week	1

Course Description

Unit-I

Introduction: Overview of automation in industry. Type of production: continuous, mass, batch and job shop and automation achievements therein. Product cycle and CAD/CAM influence CAD/CAM on product cycle.

Programmed Automation and Numerical Control: History of NC/CNC Machines. Numerical control and its basics. Coordinate system of NC machines Axis designation. NC motion control systems: point-to-point, straight-cut and continuous path control systems. Applications of NC in metal-cutting and non-metal cutting areas.

Unit-II

Computer numerical control: Block diagrams of CNC operations. Nomenclature, types and features of CNC machine tools. Elements of CNC machines and systems. Machine control unit. Position control and its significance. Engineering analysis of NC positioning systems. Open loop and closed loop systems. Precision in NC positioning systems: control resolution, accuracy and repeatability. Actuators: DC servomotor, ac servomotor, stepper motor. Transducers and feedback elements: resolvers, inductosyns optical grating and encoders.

Unit-III

Part programming: Process planning and flow chart for part programming. Tooling systems, tool nomenclature and tool geometries of modern indexable carbide tools. Tool presetting& Modular Tooling. Selection of tools based on machining capacity, accuracy and surface finish. Elements of programming for turning and milling. Composition of a part program. Preparatory codes G, Miscellaneous functions M. Interpolation, Tool compensations, cycles for simplifying programming. Part programming for typical components on turning machines and machining centres.

Computer aided programming: APT Part Programming. Introduction to computer aided programming through Pro-E.

Unit-IV

Modern CNC machines: CNC lathes. Turning centres. Machining centres. . Automatic pallet changers. Automatic tool changers. Direct numerical control and applications. CNC machine design features. Supporting structures. Guide ways. Ball screw-and-nut mechanisms. Machine spindles. Concept of rigidity and relation with accuracy.

Computer aided Inspection: Coordinate measuring machines and their applications. Introduction to machine vision and applications

	Unit-V Manufacturing Automation: Automation strategies, performances and analysis of manufacturing system. Fundamentals of Group technology (G.T), Computer Aided Process Planning (CAPP), Material requirement planning (M.R.P) Material handling system Industrial robots FMS and CIM.
Pre-Requisite Courses (/ Papers):	Production Engineering, Computer Aided Design, Fundamental of Computers
Text books:	• Automation Production System and Integrated Manufacturing, Grover M. P., Prentice Hall of India, New Delhi. • CAD/CAM Principle and Application, PN Rao, Tata McGraw Hill PublishingCo. Ltd, New Delhi.
Reference books:	• Computer Integrated Design and Manufacturing, David D. Bedworth, McGraw Hill Inc. Singapore. • CAD/CAM", Grover M.P, "Prentice Hall of India, New Delhi.
Course Objective	Computer aided manufacturing is an interdisciplinary subject area. This course tries to build fundamentals and working knowledge of the subject.
Course Outcomes	CO1: Basic uses related to CAD/CAM systems and Computer Numerical Control. Type of production, Applications of NC in metal-cutting and non-metal cutting areas. CO2: Learn CNC and positioning systems, Elements of CNC machines and systems. Machine control unit. Actuators: DC servomotor, ac servomotor, stepper motor. CO3: Part programming, Tooling systems, tool nomenclature and tool geometries of modern indexable carbide tools. Introduction to computer aided programming through Pro-E. CO4: Concepts related to modern CNC machines. Computer aided programming: APT Part Programming. Computer aided Inspection CO5: Manufacturing automation and new developments in the area like FMS, CIM, GT and MRP.
Computer Usage / Software required:	Relevant industry and simulation software.

DESIGN OF MECHANICAL SYSTEM

Paper Code	**BM-602**
Course Credits	**4**
No. of Lectures/week	3
No. of tutorials/week	1

Course Description

Unit-I

Shafts: Stresses in shaft, kinds and causes of failure in shafts. Design calculation for strength and deflection. Design of short and line shafts. Fatigue consideration. Types of couplings. Design of muff and flange coupling. Materials for shafts.

Unit-II

Bearings: Rolling and sliding elements. Nomenclature of journal bearing. Lubrication in loaded journal. Non-dimensional characteristic numbers and their application in design. Heat generation transfer in journal bearing. Thrust bearings. Ball and roller bearings. Types of roller bearing types of ball bearing. Friction in following contact bearings. Equivalent static Load, basic static and dynamic load capacities. Life and selection of roller bearing.

Unit-III

Power Transmission Systems: Types of drives. Comparison. Mechanical drives and their characteristics. Belt drives and types. Design of belts for strength. Theory and design of belt drives. Velocity ratio. Flat belts. V-belts. Selection of belts and belt materials. Surface strength and against bending. Design o chain drives.

Unit-IV

Gear: Types of gears. Modes of gear failures. Force analysis for gears. Design of spur gear based upon contact stress. Beam strength of gear teeth. Lewis form factor and other factors affecting design of gear. Dynamic and static tooth load considerations. Design of spur gears based upon wear. Gear materials.

Unit-V

Design of Gear Drives: Introduction to Gear box, Structural Diagram, Sliding-Mesh Gearing. Design calculation for spur gear (Straight tooth and inclined tooth) reducers. Materials for gears standards for spur gears. Lubrication & efficiency of a gear drive.

Pre-Requisite Courses (/ Papers): Machine Design-1, Mechanics of SolidandTheoryof Machines

Text books:

- Mechanical Engineering Design by J.E. Shigley, C.R. Mischke& R.G. Buyres. McGraw Hill Book co., 7 e.
- Fundamentals of Machine Component Design by R.C. Juvinall, John Wiley &Sons.

Reference books:	• Design of Machines Elements by M.F. Spotts, Prentice Hall of India. • Machine Elements by V. Dobrovolsky, MIR Publishers, • Machine Design by Black and Adams, McGraw-Hill Book co. • Machine Component Design by William Orthwein, Jaico Publishing House. • Machine Design by A. Mubeen, Khanna Publication
Course Objective	•Reinforce the philosophy that real engineering design problems are open-ended. •Give practice in longer open-ended problems using design methodology Give practice in longer open-ended problems using design methodology •Broaden skills in team work, critical thinking, communication, planning and scheduling through design project
Course Outcomes	CO1: Detailed analysis of shaft and various factors for fatigue. CO2: Detailed study of bearings and their industrial uses. CO3: Understanding the concept of various types of power transmission system. CO4: Complete analysis of gears and its designing. CO5: Design of Gear Drives, Materials for gears standards for spur gears. Lubrication & efficiency of a gear drive.
Computer Usage / Software required:	CATIA, PRO-E

OPERATIONS RESEARCH

Paper Code:	**BM- 603**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1
Course Description	**Unit-I** Introduction: Nature and development of operations research, general methodology of OR; applications of OR to industrial problems. Formulation of linear programming; deterministic models Linear Optimization Models: Graphical solutions. Introduction to LINDO, LINGO and related software for solving optimisation problems **Unit-II** Simplex algorithm, computational procedure in simplex, duality and its concept. Application of elementary sensitivity analysis Application of Linear Programming. Applications of simplex technique **Unit-III** Queuing Problems: Queuing systems and concepts; classification of queuing situations; Kendall's notation, solution of queuing problems, single channel, single stage, finite and infinite queues with Poisson arrival and exponential service time; applications to industrial problems. Transportation problems; methods for obtaining the solution, degeneracy in transportation problems. Stepping stone method. Trans-shipment problems. Assignment problems. **Unit-IV** Simulation: Introduction, reasons for using simulation, limitations of simulation. Steps in simulation process. Application of simulation. Computer simulation. Monte Carlo simulation. Sequencing, n jobs two stations, two jobs n stations and graphical method. Decision theory. **Unit-V** Network development, Gantt chart. Project Critical path scheduling, construction of a CPM network, the critical path. Float calculations. Project Evaluation and Review Technique and its calculations, Network applications in operations management. Project crashing and resource allocation. Newer Network methods. Mathematics I, II and III
Pre-Requisite Courses (/ Papers):	
Textbooks::	Operations Research – Introduction, Taha, H.A., Pearson Education, India

Reference books:	• Quantitative Techniques for Decision Making, Gupta M P, Prentice Hall of India. • Introduction to Operations Research by Hillier and Lieberman, Tata McGraw Hill, India
Course outcomes	• Introduction to operational research and its general methodology. Problem formulation and solution with graphical methods. • Understanding the simplex algorithm and its application in simple situations • Understanding the queuing system and concepts with basic numerical. Transportation and assignment model solutions • Introduction to simulation and its applications Decision making under uncertainty • Learning the basic knowledge of network development and project management with Project time management using CPM & PERT
Computer Usage / Software required:	MS Project 2000 (and Prima Vera), Operation research software like LINDO, LINGO, SOLVER SUIT, EXCEL etc.

REFRIGERATION AND AIR-CONDITIONING

Paper Code	**BM-604**
Course Credits	**4**
No. of Lectures/week	3
No. of tutorials/week	1

Course Description

Unit-I

Refrigerating Machine: The second law interpretation, Heat engine and Heat pump and refrigerating machine. Reversed Carnot cycle for vapour, vapour compression cycle. Actual vapor compression cycle. Effect of Super Heating, the suction vapour, super-heating with useful cooling and super-heating, which produces useful cooling. Effect of pressure losses, Liquid-Suction heat exchanger, removal Flash gas, Intercooling, Compound Compression with water inter-cooling, Compound Compression with liquid flash cooler.

Multi-pressure Systems: Multistage of compound compression, choice of intermediate pressure, complete multistage Compression system. Multi-evaporator system single compressor individual expansion valves, single compressor-multiple expansion valves, individual compressor-multiple expansion valves, individual compressors with compound compression. Cascade systems.

Unit-II

Refrigerants: classification of refrigerants, Designation of refrigerants, Selection of refrigerant, required properties of an ideal refrigerant, Secondary refrigerants, Brine.

Condenser: Air cooled condensers, water cooled condensers, heat transfer in condensers, Fouling Factor, water side co-efficient, superheating, Finned tubes air cooled and evaporative condenser.

Spray Ponds and cooling towers, and water treatment plant.

Expansion Devices: Automatic or constant pressure expansion valve, thermostatic Expansion valves. Capillary tube and its sizing.

Unit-III

Refrigeration Equipment: Evaporators: flooded evaporators, liquid chiller, direct expansion coil, Heat transfer during boiling. Fluid side heat transfer, Overall performance.

Absorption Refrigeration System: Simple vapour absorption system, Co-efficient of Performance of absorption systems. Lithium -Bromide- Absorption refrigeration system, Brief Study of Domestic Refrigerators, Solar Refrigeration, Reversed Brayton cycle.

Compressors: Types of compressor, Reciprocating, rotary and centrifugal (Brief description) Volumetric efficiency of reciprocating compressor and H.P. required. Factors affecting the performance of reciprocating compressor, Capacity control of compressor.

Unit-IV

Air-conditioning: Psychrometry, Definition of Psychometric properties, Psychrometric relations, Psychrometric chart, Psychrometric processes, Thermodynamicwetbulbtemperature, Calculation of air properties, Summer air-

	conditioning system for hot and dry outdoor conditions and for hot and humid air conditions, winter air-conditioning system, Year round air-conditioning system. **Unit-V** Requirement of comfort air Air-conditioning: Effective temperature economic consideration for selecting the comfort point, Cooling load calculation; sum load, Load from occupants, equipment load, Infiltration air load, fan load, fresh air Load. Design of air-conditioning systems, Cooling load and air quantities, Central air-conditioning system, and unitary air-conditioning system, Comfort indices, Control, Duct design
Pre-Requisite Courses (/ Papers):	Thermodynamics, Heat Transfer, & Fluid Mechanics.
Text books:	Refrigeration and Air-conditioning by C.P. Arora, McGraw-Hill.
Reference books:	• Fundamental of Refrigeration by Dossat – McGraw Hill • Refrigeration and Air-conditioning by P.L. Ballaney, Khanna. Publication
Course Objective	• Clear all concepts of Refrigeration Cycles • Clear all concepts of Heating, Ventilation and Air-conditioning systems and cycles • Introduce to Green, Intelligent Buildings • Train students to work as an HVAC Engineer.
Course Outcomes	CO1: Introduction of Refrigerating machines and multi-pressure systems. CO2: Understanding the classification and selection of refrigerants and condensers. CO3: Learning various refrigeration equipment's. CO4: Introduction to basic concepts of air-conditioning. CO5: Understanding the requirement of comfort air-conditioning
Computer Usage / Software required:	• Students can be introduced to basic simulation software such as Fluent; HEVACOMP, Primavera, and other CFD modelling techniques.
Other details regarding this course (if any)	• HVAC is a big industry & student has prospects of becoming Design Engineer; Site Engineer; Procurement Engineer; Project Engineer etc.;

INTERNAL COMBUSTION ENGINES

Paper Code	**BM - 605**
Course Credits	**4**
No. of Lectures/ week	3
No. of Tutorials/week	1
Course Description	**Unit-I** I.C. Engines: Introduction and Engine classification; Major Applications; S.I. and C.I. Engines operation; Working principles merits and demerits of 2-Stroke and 4 stroke engines; Concept of Combustion processes; Scavenging of Two Stroke Engines. Supercharging & Turbo charging. **Unit-II** S.I. Engines: Introduction- Stages of Combustion in S.I Engines, Thermodynamics analysis of Fuel-Air cycle, Abnormal Combustion, Fuel metering, carbureter and Fuel injection systems. **Unit-III** C.I. Engines: Introduction- Stages of Combustion in C. I. Engines, Significance of Delay Period. Premixed and Diffusion Combustion processes. Knocking phenomena, Types of Combustion Chambers. Fuel metering & fuel injection systems. **Unit-IV** Gas Turbine & Jet Propulsion: Thermodynamics analysis of Actual Gas Turbine Cycle. Gas Turbine Combustors. Turbojet, Turboprop, Turbofan, Ramjet and Scramjet Engines. Rocket Engines. **Unit-V** Fuels: Fuels used in S.I., C.I. Engines & Gas Turbines, Non-conventional Fuels, its Fuel characteristics and their rating. Alternative Fuels. Emission from S.I& C I Engines &itsControl.
Pre-Requisite Courses (/ Papers):	Applied Thermodynamics, Fluid Mechanics and Heat and Mass Transfer
Text books:	• Internal Combustion Engine by V. Ganesan; Tata McGraw Hill Publication
Reference books:	• Internal Combustion Engines Fundamentals by John B. Heywood; McGraw Hill • Internal Combustion Engines and Air Pollution, by Edward F. Obert Harper & Row Publishers • Internal Combustion Engine by Sharma &Mathur; DhanpatRai& Sons
Course Objective	• To impart knowledge and understanding of basic concept and working of different types of Engines. • To make the student capable enough to be employed by Engine Manufacturers.

Course Outcomes	CO1: Expanding the knowledge of different type of engines with working principles, merits and demerits CO2: Learning the stages of combustion for S.I engine and its thermodynamic analysis CO3: Detailed analysis of stages of combustion for C.I engine and fuel injection system CO4: Thermodynamic analysis of gas turbine and jet propulsion. CO5: Understanding the behaviour of fuel in various engines and turbines.
Computer Usage / Software required:	Dynomation-5; Engine simulation and other related software

Course Structure Description

B.Tech.(Mechanical Engineering)

SEVENTH Semester

DYNAMICS OF MACHINE AND MECHANICAL VIBRATIONS

Paper Code	**BM-701**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-1

Cams: Types of cams and followers. Displacement, velocity, and acceleration diagrams for usual motion of followers. Cam profiles for knife-edge, roller and flat-faced followers. Cam size determination. Determination of motion of the follower for specified cam profiles.

Unit-II

Inertia Force Analysis: Simple and compound pendulums. Inertia force and inertia couple. Dynamically equivalent systems. Equilibrium of a link in a mechanism. Inertia force in reciprocating engines. Inertia forces in a four bar linkage. Turning moment diagrams. Fluctuation of speed and energy. Flywheel.

Unit-III

Balancing: Introduction to static and dynamic balancing. Balancing of a single and a number of rotating weights by another weight rotating in the same plane. Balancing of a number of weights rotating in different planes. Balancing of reciprocating parts of an engine. Partial balancing of primary forces. Balancing of two and four cylinder in a line engine. Balancing of V /radial engines. Direct and reverse crank method. Balancing machines.

Unit-IV

Gyroscope: Gyroscopic couple and processional motion. Effect of gyroscopic couple on a movement of aero planes, Naval ships, four wheel and two wheel vehicles. Gyroscopic Analysis for rotating shaft with inclined disc and Grinding Mills. Introduction to Gyro dynamics.

Unit-V

Governors: Function of a governor, governor's types, working of Watt Porter, Proell and Hartnell governor with and without the effect of friction at the sleeves. Qualities of a governor- sensitiveness, stability, isochronisms and hunting. Effort and power. Controlling force of a governor.

Pre-Requisite Courses (/ Papers): Theory of Machines

Text books:

- Theory of Mechanism and Machines by Ghosh &Malick, Affiliated East-West Publications.
- Theory of Machines by Thomas Bevan CBS Publishers and Distributor, N. Delhi.

Reference books:

- Theory of Machines and mechanisms, Shigley, MGH
- Mechanism and Machine Theory by J.S. Rao and R. V Oukkipati,· Wiley

	Eastern
Course Objective	The student is to learn and demonstrate proficiency in mechanism kinematics, graphical and analytical linkage synthesis, linkage position analysis, linkage velocity analysis, linkage acceleration analysis, and dynamic linkage force Analysis.
Course Outcomes	CO1: Understanding the concepts of cams and followers. CO2: Analysis of inertial force for simple and compound pendulums. CO3: Introduction to static and dynamic balancing. CO4: Gyroscope: Gyroscopic couple and processional motion. Effect of gyroscopic couple on a movement of aero planes, Introduction to Gyro dynamics. CO5: Governors: Function of a governor, governor's types, working of Watt Porter, Controlling force of a governor.
Computer Usage / Software required:	• Demonstrate a good understanding of the principles of mechanisms and machines, and their practical applications in mechanical Engineering. • Solve problems involving linkage mechanisms, balancing, and power transmission through clutches, chains, belts, gears, etc. • Select suitable mechanisms for various applications including, cams and governors. • Use friction as an advantage in mechanical engineering. Reduce friction otherwise to minimise energy losses. • Gain confidence in solving problems related to various mechanisms.

PRODUCTION ENGINEERING -II

Paper Code	**BM-702**
Course Credits	**4**
No. of Lectures/ week	3
No. of Tutorials/week	1

Course Description

Unit-I

Metrology Inspection: Linear and angular measurements by mechanical and optical method. Limits and fits. Precision gauge block, pneumatic gauging. Interferometry -e.g. optical flats, measurement of straightness, flatness, roundness, squareness and symmetry. Surface measurements e.g. surface roughness. Measurement of major diameter, minor diameter and effective diameter by bench micrometer. Errors in pitch and thread form by optical method. Measurement of gears to determine errors in run out, profile. Pitch, pressure angle and tooth thickness by anyone method. Testing for alignment of shaft. C.N.C. Measuring equipment of gears.

Unit-II

Jigs and Fixtures: Types of tools. Usefulness of Jigs and Fixtures. Underlying principles of jigs and fixtures design. Principles and types of locating and clamping devices. Elements of a drilling jig and types of jigs. Elements of a milling fixtures and types of milling fixtures. Economics of jigs and fixtures.

Unit-III

Grinding: Process of grinding, surface measurement, use of gauges and comparator. Grinding wheels, materials and codes, wheel dressing. Grinding operations, materials for grinding.

Unit-IV

Non-Conventional methods of manufacturing Electro discharge machining, electro-chemical milling, electro-chemical grinding, electro-chemical turning, chemical milling, abrasive jet machining, ultrasonic machining. Hot Machining. Electron beam machining. Plasma Arc Machining.

High velocity forming of metals, Explosive fabrication. Electro-hydraulic technique.

Unit-V

Properties and Processing of Plastics: Structure and Properties of Plastics, Factors affecting Polymer Properties, Casting of Plastics, Moulding of Plastics, Compression Molding, Injection Moulding, Rotomoulding, Blow Moulding, Reinforced Plastic Moulding, Pultrusion, Filament Winding, Machining of Plastics, Powder Metallurgy.

Pre-Requisite Courses (/ Papers): Material Science, Production Engineering-I, Manufacturing Processes, Workshop Practice-I & II.

Text books:

- Manufacturing Science, by Mallik A and Ghosh, Affiliated East- West Press Pvt., Ltd.

Reference books:	• Fundamentals of Metal Machining and Machine Tools, by Geoffrey Boothroyd, McGraw-Hill International Book Co. • Fundamentals of Tools Design by Wilson, Prentice Hall. • Processes and Materials of Manufacture, by Roy A. Lindberg, PHI Learning. • Manufacturing Technology by John R. Lindberk Molly W. Williams and Robert M. Wygant. • Technician Manufacturing Technology by M. Hazlehurst (English Language Book Society. • Introduction to the theory of Plasticity for Engineers by Hoffman and George Sachs McGraw-Hill.
Course Objective	• To demonstrate the fundamentals of metrology and inspection. • To develop knowledge and importance of jigs and fixtures. • To develop fundamental knowledge on grinding of materials. • To develop knowledge and importance of non-conventional manufacturing processes. • To demonstrate the fundamentals of properties and processing of plastics.
Course Outcomes	CO1: Understand various methods of inspection and measurement used in industries. CO2: Understand design and use of jigs and fixtures. CO3: Understand the application of metal grinding processes. CO4: Understand the application of non-conventional manufacturing methods in different manufacturing situations. CO5: Identify the properties and processing of plastics.
Other details regarding this course	The course is of predominantly important in industry and requires industry interaction

TURBO-MACHINES

Paper Code	**BTM-703**
Course Credits	**4**
No. of Lectures/week	3
No. of tutorials/week	1
Course Description	**Unit-I** Definition and classification of turbomachines; Principles of operation; Energy transfer in turbomachines; Similarity; Specific speed and shape number. Impact of jet: Impulse momentum equation and its applications, Jet propulsion. Moment of momentum equation, Euler's equation for turbomachines. **Unit-II** Hydraulic Pumps: Centrifugal pumps; main components and working principle, head and efficiencies, net positive suction head, priming, performance characteristics curves. Reciprocating pump; main components and working principle, slip of pump, effect of piston acceleration, indicator diagram, air vessels. Miscellaneous types of pumps. **Unit-III** Hydraulic Turbines: Introduction, classification of hydraulic turbines, Pelton, Francis and Kaplan turbines, Propeller turbine, design of runner, draft tube theory, governing of turbines, performance and regulation of hydraulic turbines, Cavitation in pumps and turbines. **Unit-IV** Compressors, Blowers and Fans: Reciprocating, Centrifugal and Axial flow compressors; multi-stage compression. Flow through blowers and fans. **Unit-V** Gas turbines – aircraft propulsion, gas turbine compressors, diffusers and combustion systems. Wind turbines and Propellers; Fluid couplings and torque converters; Unconventional turbo machines.
Pre-Requisite Courses:	Fluid Mechanics –I and II, Applied Thermodynamics
Text books:	Shepherd, D. G., Principles of Turbomachinery, Macmillan.

Reference books:	• Cherkassky, V. M., Pumps, Fans and Compressors, Mir Publishers, • Yahya, S. M., Turbines, Fans and Compressors, • Douglas, J.F., Gasiorek, J.M., Swaffield, J.A., and Jack, L.B., Fluid Mechanics, Pearson Education, Ltd. • Sayers, A.T., Hydraulic and Compressible Flow Turbo machines, McGraw Hill, 1990. • Saravanamuttoo, HIH. Cohen, H., Rogers, GFC. Gas Turbine Theory, Pearson Education, Ltd. • Wright, T., Fluid Machinery: Performance, Analysis and Design, CRC Press, • Lefevre, A. H., Gas Turbine Combustion, Taylors & Francis
Course Objective	To provide basic understanding of working and associated principles of Turbo Machines. This includes turbines, compressors, pumps, blowers, fans and other associated devices.
Course Outcomes	CO1: learning definitions and basic principles of turbo machine. CO2: Learning classification, principles of operation and related uses of hydraulic pumps. CO3: Learning classification, principles of operation and design of different types of hydraulic turbines. CO4: Understand the working of compressors, fans and blowers. CO5: learning basic principles of gas turbines. Wind turbines and Propellers; Fluid couplings and torque converters; Unconventional turbo machines
Computer Usage / Software required:	e.g. MATLAB, EXCEL, EES, Fluent, STAR-CD etc.

ENERGY SOURCES

Paper Code	**BM-704**
Course Credits	**4**
No. of Lectures/week	**3**
No. of tutorials/week	1

Course Description

Unit-I

Introduction: Sources of conventional and renewable energy, Trends of energy consumption, Fossil fuel availability and limitations, Need to develop new energy sources. Energy Economy.

Unit-II

Solar Energy: Solar radiation, characteristics and estimation, Solar Collectors, Flat Plate and concentrating types; Their comparative study, design; Heating of air and water for building and other uses, Thermal storages, Solar Ponds, Solar pumps, Solar Power, Solar Cookers etc. Direct Conversion of Solar energy to electricity.

Unit-III

Biomass Systems: Biomass conversion – Combustion, gasification, aerobic digestion, pyrolysis, digesters and their design; Performance analysis & testing – Thermal applications & power generation.

Unit-IV

Wind Energy: Wind turbines and their characteristics; Types of rotors, horizontal axis and vertical axis systems, system design, site selection and Performance analysis. Tidal Energy: Sites, potentiality and possibility of harnessing from site, limitations.

Unit-V

Geo-thermal Energy: Sites, potentiality and limitation, study of different conversion systems.

Ocean Energy: Principle of utilization and its limitations, description of various systems. Energy from waste and other sources.

Pre-Requisite Courses

Fluid Mechanics I&II, Applied Thermodynamics, A.T.H.T

Text books:

- G.N. Tiwari & S. Suneja: Solar Thermal Energy Systems, Narosa Publishing House

Reference books:

- S.P. Sukhatme: Solar Energy – Principles of Thermal Collection & Storage, Tata McGraw Hill.
- H.P. Garg: Advances in Solar Energy Technology, D. Reid Publishing House
- A.N. Mathur and N.S. Rathore: Biogas Production, Management and Utilization, Himansu Publications.

	• K.C. Khandelwal& S.S. Mandi: Practical Hand Book of Biogas Technology
Course Outcomes	CO1: Introduction to unconventional manufacturing process and its classification. CO2: Understanding the principles and working of various unconventional machining processes. CO3: Brief study of applications of unconventional machining processes. CO4: Unconventional Welding processes: Explosive welding, Cladding, under water welding, Metalizing, Plasma arc welding Laser Beam welding, Friction Stir welding. CO5: Principle, working and applications of high energy forming processes such as explosive forming, Electromagnetic forming, Electro-Discharge forming, Water hammer forming, Explosive compaction.

INDUSTRIAL ENGINEERING

Paper Code	**BM-705**
Paper Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Systems approach, Definition and scope of Industrial Engineering. Historical developments. Production and production systems. Brief about basic areas of industrial engineering. Productivity. Site location and factors affecting site location. Assembly line balancing. Learning curve.

Unit-II

Motion and Time Study: Process Analysis: Process chart, activity charts, man and machine charts and operation process charts.

Motion study: Motion analysis, camera study, micro motion study, cyclograph and Chronocyclograph. Fundamental hand motions. Principles of motion economy and human body, arrangement of workplace in respect of tools and equipment

Time Study: Information recording, data recording by continuous, repetitive and cumulative timing, determining number of observations, the rating factor, performance rating, allowances determination, normal and standard time.

Synthetic time and introduction to predetermined times. Work sampling: theory, procedures, and applications.

Unit-III

Inventory: Inventory concepts, inventory costs. Inventory models assuming certainty and quantity discounts. Inventory management. ABC analysis. Material Requirement Planning (MRP).

Introduction to Enterprise Resource Planning. Just in Time, Supply Chain Management and critical chain. Material Handling.

Unit-IV

Quality: Definition, dimension and related concepts. Economics of quality. Acceptance sampling by attributes, Operating characteristic curve, producing and consuming risks, single, double and sequential sampling plans. Acceptance sampling by variables. Average outgoing quality.

Unit-V

Quality Management: Control charts for variables. Control chart for attributes. Seven Quality control tools Quality Circle. Quality Systems, Total Quality Management.

Pre-Requisite Courses (/ Papers): Operation Research, Engineering Economy and Management.

Text books:

- Motion and Time Study Design and Measurement of Work", Ralph M. Barnes, John Wiley & Sons. New York.

	• Introduction to Statistical Quality Control, Douglas C. Montgomery, John Wiley & Sons. New York
Reference books:	• Martinich, Joseph S, "Production and Operations Management: An Applied Modern Approach," John Wiley, Re. Ed
Course Objective	Industrial Engineering has evolved and established itself as a branch of engineering. A basic overview of different areas covered in this branch of engineering is provided.
Course Outcomes	• Systems approach, Industrial Engineering with basic concepts as related to productivity, quality, inventory, site location, learning curves, assembly line. New emerging areas • Motion Study by charts, camera studies. Fundamental hand motions with an introduction to Principles of motion economy. Time Study, Synthetic time, Work sampling • Inventory concepts, costs, basic models. Inventory management for dependent and independent demand. Introduction to Just in Time, Supply Chain Management and critical chain. Material Handling. • Quality its definition, dimension and related concepts. Economics of quality. Quality control by Acceptance sampling both for attributes and variables • Understanding the concept of quality management, Control charts for both variable and attributes, Concept of TQM.
Computer Usage / Software required:	• E.g. EXCEL and other Industrial Engineering Software.
Other details regarding this course	This course is of predominantly important in industry and needs lots of industrial visits and awareness of what best practices are being followed.

Course Structure Description

B.Tech.(Mechanical Engineering)

EIGHT Semester

PRODUCT DESIGN

Paper Code	**BM - 801**
Course Credits	**4**
No. of Lectures/week	4
No. of Tutorials/ week	
Course Description	**Unit - I** Significance of product design, product design and development process, sequential engineering design method, the challenges of product development. Introduction to AM Theory of inventive problem solving (TRIZ): Fundamentals, problem Solution, methods and techniques, General Theory of Innovation and TRIZ, Identifying Customer needs: Gather raw data from customers, interpret raw data in terms of customer needs, organise the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications **Unit - II** Concept Generation: The activity of concept generation clarifies the problem, search externally, search internally, explore systematically, and reflect on the results and the process.Concept Selection: Overview of methodology, concept screening, and concept scoring. Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, and reflect on the results and the process. **Unit - III** Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. Design of Modular System – abstract design. The process of conception and its documentation **Unit – IV** Computer-aided design (CAD), need for CAD, components of CAD systems, advantages. Various design tools in product development, product development process stages, QFD, concurrent engineering.Value engineering Applications in Product development and design, Model-based technology for generating innovative ideas. 3D scanner: its types with scanning principle, applications.Overview of Steinbichler blue light 3D scanner, different components function and working principle. Rhinoceros 3D software, **Unit – VI** Differentiate Additive manufacturing from subtractive manufacturing. Step used to create a 3D model. Different technologies used in additive manufacturing

	technologies like Stereolithography (SLA), Selective laser sintering (SLS), Fused deposit modeling (FDM), Selective Laser Melting (SLM), Laminated Object Manufacturing (LOM), Direct Metal Laser Sintering (DMLS), Inkjet Printing (IJP), Polyjet 3D printing, binding jet 3D printing, Built mechanism of each technology, applications. Overview of Colour-Jet 3D Printing (CJP), working principle, the material used, post processing in CJP. Project, seminar and exercises related to the above topics
Pre-Requisite Courses (Papers):	Production Engineering, Industrial Engineering, Computer Aided Design, Basics of Machine Design
Textbooks:	• Product Design and Development, Karl. T. Ulrich, Steven D Eppinger, Irwin Mc Graw Hill-
Reference books:	• Product Design, Pearson Engineering of creativity: an introduction to TRIZMethodology of Inventive Problem Solving, By Semyon D. Savransky, CRC Press. • Inventive thinking through TRIZ: A practical guide; By Michael A. Orloff, Springer. • Systematic innovation: An introduction to TRIZ; (theory of inventive Problem. • Product Design for Manufacture and Assembly, Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, “ • Product Design: Fundamentals and Methods, Roozenburg and Eekels, Publisher: McGraw-Hill • Design Secrets: Products: 50 Real-Life Projects Uncovered - Industrial Designers, Goodrich, Kristina; Society of America, Publisher: Rockport Publishers June 2001 • Creating Breakthrough Products: Innovation from Product Planning to Program Approval, Cagan, Jonathan; Vogel, Craig M, Publisher: Financial Times Prentice Hall; 2002
Course Objective	This is an interdisciplinary subject area. This course tries to build fundamentals and working knowledge of product design.
Course Learning Outcomes	Students will be able to learn the following • Acquire knowledge and essential skill regarding product design and development. TRIZ and its importance, Identifying Customer, needs towards product design • Concept generation and concept testing with the purpose • Product architecture, Design of modular system – abstract design. The process of product conception and its documentation • 3D scanning and its usage for product design and development, Product design tools like Value Engineering and QFD • Study different types of important3D printingtechnologieswith usage. Learning the operation of a Projet 3D Printing machine

Computer Usage / Software required:	Relevant software on scanning, inspection, reverse engineering, FEA and multi-body analysis needs to be practised.
Other details regarding this course	Product design is being taught through the foundation of theory and also engaging students in loosely supervised practice and industry exposure.

ROBOTICS

Paper Code	**BM-802**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	**1**

Course Description

Unit-I

Fundamentals of Robotics:

Introduction, Automation and Robotics, A Brief History of Robotics, Laws & Definition of Robot Anatomy & Classification of Robots, Human system & Robotics, Specifications of Robot, Work Volume, Precision of Movement. The Robotics Market, Social Issues and the Future Prospects.

Unit-II

Robot Arm Kinematics:

Introduction to Robot Arm Kinematics, Homogeneous Coordinate transformations, Direct & Inverse Kinematics, Composite Homogeneous transformation matrix. Link, joint and parameters. DenavitHarten Berg Notation, D-H Matrix, Kinematic equations. Exercises on Direct & Inverse Kinematics up to six degree of freedom Robots.

Unit-III

Robot Grippers:

Classification of End Effectors, Mechanical Grippers, Magnetic gripper, Vacuum gripper, Adhesive gripper, Multifingered gripper - Utah, Okada, Stanford, DGIT Hands. Considerations in Gripper Selection - Force Analysis and Design.

Unit-IV

Robot Drives, Sensors, Actuators and Control:

Robot drive systems-Hydraulic, Pneumatic & Electric. Robot Sensors - Contact & noncontact type sensors, Force & torque Sensor. Robotic vision system. Basic Control Systems Concepts and Models, Controllers, Control System Analysis.

Unit-V

Robot Programming-Languages & Applications in Manufacturing.

Methods of Robot Programming, Lead through Programming Methods. Robot Languages & classification. Programming Exercise on ACL/ATS for Robots EshedRobots .

Robot Application areas- Material Transfer and Machine Loading/ Unloading, Processing Operations, Assembly and Inspection**,** Future Manufacturing Applications Robots.

Pre-Requisite Courses (/ Papers):	Kinematics & Dynamics of Machines, Instrumentation & Control Engineering.

Text books:	1. "Robotics" by S.K.Saha,Tata *McGraw-Hill Pvt.Ltd.* 2. .Industrial Robotics" by M.PGroover, *McGraw-Hill International Editions.*
Reference books:	1. "Introduction to Robotics": by J.J Craig., Addison Wesley N Delhi. 2. "Robotics" by K.S.Fu., *McGraw-Hill International Editions.*
Course Objective	To provide an introduction to Robotics including robot classification, design and selection, analysis, sensing and control, and applications in industry.
Course Outcomes:	CO1: Introduction of fundamentals of robotics and automation. CO2: Understanding the concepts of robot arm kinematics and its applications. CO3: Learning the concepts of robot grippers and its classifications. CO4: Understanding the working of robot drives, sensors, actuators and control. CO5: Learning the robot programming language and its applications in manufacturing.

AUTOMOBILE ENGINEERING

Paper Code	**BM-803**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Components of Automobile and their compositions, chassis, Power unit,general layout of automotive vehicle, Engine performance characteristics, Turbo charging and supercharging, Multi cylinder engines and their arrangements, Firing order

Unit-II

Rolling, air or wind and gradient resistance, Power requirement, Matching of engine power with demand power, Tractive effort, Vehicle performance, Gear Box, Drive effectiveness, Relationship for two and four-wheel vehicles.

Unit-III

Power transmission, Clutch and its types, Gear boxes—Sliding mesh, constant mesh, synchromesh and epicyclic arrangements, Propeller shaft, universal joint, Differential and its analysis, live axle, floating and full floating axle system.

Unit-IV

Steering system, steering geometry—camber, castor, king pin rake, combined angle toe in, Types of steering mechanisms: Ackerman steering mechanism, Davis steering mechanism, steering linkages, power steering.
Tyres and its types, specifications and construction, tyres ground contact area, material and disposal of tyres.

Unit-V

Suspension system and its need, types of suspension system—Rigid axle suspension system, torsion bar, Independent suspension system, shock absorbers.
Braking system, mechanical braking system, disc and drum brakes, hydraulic brakes, master cylinder, wheel cylinder, tandem cylinder, brake fluid and its properties, weight transfer during braking and stopping distances.

Pre-Requisite Courses (/ Papers): Thermodynamics, Fluid Mechanics, Heat and Mass Transfer

Text books:

- The motor vehicle by K. Newton, W. Steeds and T. K. Garret, ESBS Publications

Reference books:

- Automobile Engineering by G. B. S. Narang
- Automotive Mechanics—Principles and practices by Heitner Joseph , East-West Press
- Automobile Engineering, Kirpal Singh, Standard Publishers
- Automotive Chassis, by P.L. Kohli, Papyrus publications
- Auto mechanics, by Michell, McGraw Hill Publications.
- Automobile Engineering by S K Gupta, S Chand publisher
- Automobile Engineering by D S Kumar, S K Kataria and Sons.

	• Automotive Technology, Heinz and Hizler, ELBS Edition
Course Objective	• To develop an understanding of basics of an automobile function. • To make students competent enough to be absorbed in automobile industries.
Course Outcomes:	CO1: Introduction to components of automobile and their composition. CO2:Learning the concepts of rolling with various resistance gradients and developing relationship between two and four-wheel vehicles. CO3: Understanding the concepts of power transmission. CO4: Learning the concepts of steering system. CO5: To learn about suspension systems; braking systems.
Computer Usage / Software required:	Relevant Industry software
Other details regarding this course	This course is of predominant importance in automobile engineering and its Indian perspective for Mechanical Engineering.

ERGONOMICS

Paper Code	**BM-804**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	**1**

Course Description

Unit-1

Introduction to ergonomics, scope of ergonomics, cost of ignoring ergonomics, result of application of ergonomics, Ergonomics and its areas of application in the work-system, Description of Human-Machine system. Standard format for describing human-machine system.

Unit-II

Muscular Work: Physiological Principles, Sources of Energy, Nervous control of movements and structure of nervous system: Types of nervous system, Neurons, Action potential, Sodium potassium pump, innervations of muscles, Reflex-arc. Dynamics and static muscular work. Field method for assessing physical overload.

Unit-III

Design aspect in ergonomics: Manufacturing work-station design; Determining work-station design parameters, Systematic approach for determining work-station design, determining work-station dimension. Tool evaluation and design: Principles of tool design (General principles, Anatomical concern, and Single handle); Attributes of common industrial hand tools, Attributes of common industrial power tools, Tool evaluation check list. Displays and controls.

Unit-IV

Cumulative Trauma Disorder: Work-related Musculoskeletal Disorder: Definition of work-related Musculoskeletal Disorder, Types of WMSDs, Factors affecting WMSDs. Occupational Human Vibration: Characteristics of vibration, Whole-body and hand-arm vibration, Effect of vibration on comfort, health and performance.

Unit-V

Sound and related studies: Definition, evaluation of noise, combining decibels. Levels and Spectra: Sound power level, sound intensity level, numerical problems on sound its measurement

Pre-Requisite Courses (/ Papers): Industrial Engineering

Text books:

- Introduction to Ergonomics-R.S. Bridger, McGraw-Hill International Edition.

Reference books:

- Industrial Noise Control-Lewis H-Bell and Douglas H-Bell, Marcel Dekker, INC.
- Fitting Tasks to Human, Kroemer, K.H.E. and Grandjean, E. (1997).

	Philadelphia: Taylor and Francis • The Ergonomic Edge-MacLeod, D. (1995). New-York: Van NostrandReinhold.
Course Objective	• Provide students with the basis of occupational ergonomics. • Ergonomic considerations in design, ergonomic consideration in re-design and research basis of ergonomics.
Course Outcomes	CO1: Understand the fundamental of ergonomics (Human Factors) principles of design and evaluation. CO2: Be able to describe an expanded view of ergonomics, which encompasses more than ergonomically related injuries but all parts of assuring that the work-place fits the worker. CO3: Be able to put ergonomic assessments and solutions to practical use in the work place. CO4: Will be capable of initiating evaluations of ergonomic issues and working with an ergonomist. CO5: Understanding the concept of Sound and related studies, Numerical problems on sound its measurement
Computer Usage / Software required:	Adobe Acrobat Reader, Power Point or PP viewer, Video Player.