CBCS SCHEME

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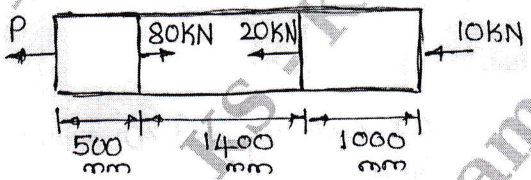
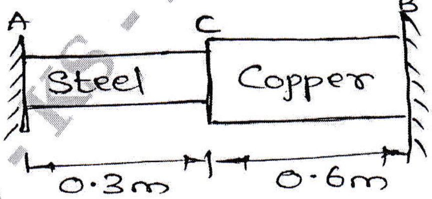
BME301

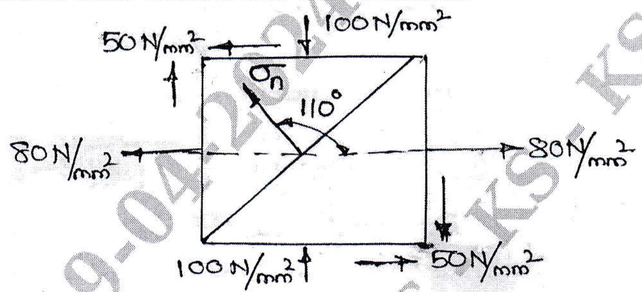
Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	State Hooke's law. Draw a neat diagram of stress-stain curve for mild steel and mark the salient points and zones.	5	L2	CO1
	b.	Derive an expression for elongation in a tapered bar of circular cross-section, subjected to an axial tensile load "F".	7	L3	CO1
	c.	A brass bar having uniform cross-section area of $300mm^2$ is subjected to a load as shown in Fig.1(c). Find the total elongation of bar and the magnitude of load "P" if, E = 84GPa.  Fig.Q.1(c)	8	L3	CO1
		OR			
Q.2	a.	Define the following: i) Poisons ratio ii) Bulk modulus iii) Factor of safety iv) True stress v) Hardness.	5	L2	CO1
	b.	A bar of 20mm diameter is tested in tension. It is observed that when a load of 37.7kN is applied, the extension measured over a gauge length of 200mm is 0.12mm and contraction in diameter is 0.0036mm. Find Poisson's ratio and elastic constants E, G, K.	7	L3	CO1
	c.	A stepped bar is fixed at its two ends rigidly. The bar is free from stresses when its temperature is 30°C. When the temperature is increased to 90°C, determine: i) Stresses induced in copper and steel portions. ii) Displacement at the junction point "C". Take E_c = 100GPa, E_s = 200GPa, $\alpha_c = 1.8 \times 10^{-5}$/°C and $\alpha_s = 1.2 \times 10^{-5}$/°C, $A_s = 80mm^2$, $A_c = 120mm^2$.  Fig.Q.2(c)	8	L3	CO1

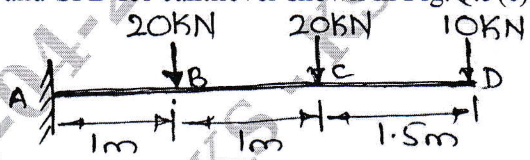
Module – 2

Q.3	**a.**	Define: i) Principal plane ii) Principal stress iii) Maximum shear stress iv) Plane of maximum shear.	**8**	**L2**	**CO2**
	b.	An element with the stresses acting on it is shown in Fig.Q.3(b), by Mohr's circle method find: i) Normal and shear stress acting on a plane whose normal is at an angle of 110° with respect to x-axis ii) Principal stresses and their locations. iii) Maximum shear stresses and their locations.  Fig.Q.3(b)	**12**	**L3**	**CO2**

OR

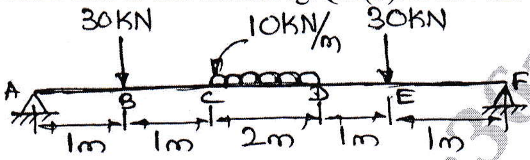
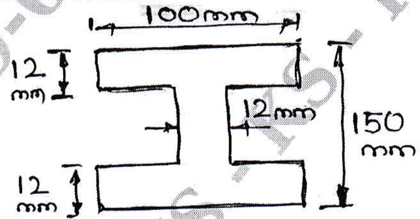
Q.4	**a.**	Derive expressions for circumferential and longitudinal strains in thin cylinder. Hence show that volumetric strain is $\epsilon_v = \frac{pd}{4tE}(5 - 4\gamma)$	**8**	**L3**	**CO2**
	b.	A cast iron pipe has 200mm internal diameter and 50mm metal thickness. It carries water at a pressure of 5N/mm^2. Calculate the intensities of circumferential and radial pressures. Sketch the stress distribution across the section.	**12**	**L3**	**CO2**

Module – 3

Q.5	**a.**	Discuss about different types of beams and loads.	**6**	**L2**	**CO3**
	b.	Obtain a relation between load intensity, shear force and bending moment.	**6**	**L3**	**CO3**
	c.	Draw the BMD and SFD for cantilever shown in Fig.Q.5(c).  Fig.Q.5(c)	**8**	**L3**	**CO3**

OR

Q.6	**a.**	Define: i) Point of contraflexure ii) Bending moment iii) Shear force.	**6**	**L2**	**CO3**

	b.	A simply supported beam is shown in Fig.Q.6(b). Draw the SFD and BMD.  Fig.Q.6(b)	14	L3	CO3
		Module – 4			
Q.7	a.	List the assumptions made in theory of pure bending. Derive the bending equation with usual notations.	10	L3	CO4
	b.	A simply supported beam of 5m span has a cross-section 150mm × 250mm. If the permissible stress is $10 N/mm^2$. Find: i) Maximum UDL intensity ii) Maximum concentrated load "P" at 2m from one end.	10	L3	CO4
		OR			
Q.8	a.	A uniform I-section beam is subjected 100kNm bending moment. Plot the stress variation across the section.  Fig.Q.8(a)	10	L3	CO4
	b.	A cantilever of square section 200mm × 200mm and length 2m, fails in flexure when 12kN is placed at free end. A rectangular beam of same material and simply supported over length of 3m, 150mm wide and depth 300mm. Calculate minimum central concentrated load required to break the beam.	10	L3	CO4
		Module – 5			
Q.9	a.	Derive torsion equation. Also list the assumptions.	10	L3	CO5
	b.	Find the shaft diameter required to transmit 60kW at 150rpm, if maximum torque is 25% more than mean torque for a maximum shear stress of 60MPa. Find angle of twist for a 4m length. Take, G = 80GPa.	10	L3	CO5
		OR			
Q.10	a.	Derive an expression for critical load in a column subjected to compressive load, when one end fixed and other free.	10	L3	CO5
	b.	A 1.5m long column has a circular cross-section of 50mm diameter. One end of column is fixed and other end is free. Taking FOS = 3. Calculate safe load using i) Rankines formula, yield stress $560 N/mm^2$ and $a = \frac{1}{1600}$ ii) Eulers formula, E = 120GPa.	10	L3	CO5

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BME302

Third Semester B.E./B.Tech Degree Examination, Dec.2023/Jan.2024
Manufacturing Process

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define a gating system. Explain with sketches types of gating system.	10	L1	CO1
	b.	Explain with a neat sketch CO_2 moulding process.	10	L2	CO1
		OR			
Q.2	a.	Define pattern and explain with a neat sketches any four pattern allowances.	10	L1	CO1
	b.	Explain in detail the procedure to determine grain fineness number of greens and in foundry lab.	10	L2	CO1
		Module – 2			
Q.3	a.	Explain with a neat sketch coreless induction furnace.	10	L2	CO2
	b.	Explain with a neat sketch cupola furnace.	10	L2	CO2
		OR			
Q.4	a.	Explain with a neat sketch centrifugal casting process.	10	L2	CO2
	b.	Explain with neat sketches casting defects.	10	L2	CO2
		Module – 3			
Q.5	a.	Illustrate the following metal forming processes with neat sketches : i) Bending ii) Piercing iii) Blanking.	10	L2	CO3
	b.	Explain the following yield criteria : i) Tresca yield criteria ii) Von-Mises yield criteria.	10	L2	CO3
		OR			
Q.6	a.	Describe compound and progressive die processes.	10	L2	CO3
	b.	Explain the importance of temperature in metal forming and write the differences between hot working and cold working.	10	L2,1	CO3
		Module – 4			
Q.7	a.	Explain with neat sketches types of flames produced in OXY-Acetylene welding.	10	L2	CO4
	b.	Explain with a neat sketch OXY-Acetylene gas welding process.	10	L2	CO4
		OR			
Q.8	a.	Explain with a neat sketch MIG welding and mention its advantages, disadvantages and applications.	10	L2	CO4
	b.	Explain with a neat sketch Manual metal arc welding and also mention its advantages, disadvantages and applications.	10	L2	CO4
		Module – 5			
Q.9	a.	Explain with neat sketches welding defects.	10	L2	CO5
	b.	Explain with a neat sketch residual stresses in welded structures.	10	L2	CO5
		OR			
Q.10	a.	Describe the following : i) Soldering ii) Brazing.	10	L2	CO5
	b.	Explain with a neat sketch resistance welding process.	10	L2	CO5

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BME303

Third Semester B.E./B.Tech Degree Examination, Dec.2023/Jan.2024
Material Science and Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Calculate the APF for FCC and BCC unit cell in crystal structure.	10	L3	CO1
	b.	Enumerate the type of crystal imperfections and explain briefly with a suitable sketch grain boundary and twin boundry defects.	10	L2	CO1
		OR			
Q.2	a.	Explain briefly with suitable sketches the plastic deformation by Slip and Twinning.	10	L2	CO1
	b.	Define the following terms : i) Unit cell and space lattice ii) Coordination number.	5	L2	CO1
	c.	Molybdenum has BCC and a density of 10.2×10^3 kg/m^3. Calculate its atomic radius. The atomic weight of molybdenum is 95.94gm/mol. $N_A = 6.023 \times 10^{23}$ atoms/mol.	5	L3	CO1
		Module – 2			
Q.3	a.	Draw neatly the solid solution binary phase diagram of a Ni-Cu system and explain briefly.	10	L2	CO2
	b.	State and explain briefly the Fick's 1st and 2nd law of diffusion.	10	L2	CO2
		OR			
Q.4	a.	Explain briefly with a neat sketch the eutectic system of two components completely soluble in liquid state and partially soluble in solid state.	08	L2	CO2
	b.	Draw a neat sketch of iron-carbon equilibrium diagram and show all phases on the diagram also show the three invariant reactions.	12	L2	CO2
		Module – 3			
Q.5	a.	Explain briefly mechanism of solidification with suitable sketches.	10	L2	CO3
	b.	With a suitable sketch explain normalizing heat treatment process.	10	L2	CO3
		OR			
Q.6	a.	Draw a neat labeled Time-Temperature Transformation [TTT] diagram for Eutectoid steel (0.8%C) and explain briefly.	10	L3	CO3
	b.	With a neat sketch briefly explain Aaustemperign and Martempering heat treatment process.	10	L2	CO3
		Module – 4			
Q.7	a.	With a flow chart, explain briefly the powder metallurgy process and its applications.	10	L2	CO4
	b.	Enumerate the different powder production methods, with suitable sketch explain atomization method.	10	L2	CO4
		OR			
Q.8	a.	Explain briefly thermal spray coating with suitable sketch. Mention the advantages of surface coatings and treatments.	10	L2	CO4
	b.	Advantages and limitations of powder metallurgy process.	10	L2	CO4

		Module – 5			
Q.9	a.	Classify engineering metals. Enumerate the types of cast iron and mention the compositions, properties and applications.	10	L2	CO5
	b.	With a neat sketch, explain the production of composite by : i) Filament winding process ii) Bag molding process.	10	L2	CO5
		OR			
Q.10	a.	With a suitable sketch explain the production of metal metric composite by stir casting process.	10	L2	CO5
	b.	What are the factors affecting the selection of materials explain briefly.	10	L2	CO5

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BME304

Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of thermodynamic data handbook and steam tables is permitted.
4. Assume missing data suitably.

		Module – 1	M	L	C
Q.1	a.	State Zeroth law of thermodynamics and justify how it forms the basis for temperature measurement.	05	L1	CO1
	b.	Derive an expression for P-dV work for a process in which (i) PV = C (ii) $PV^n = C$ where C is a constant.	05	L2	CO1
	c.	The temperature scale by a certain thermometer is given by the relation $t = a \ln x + b$ where 'a' and 'b' are constants and x is the thermometric property of the fluid in the thermometer. If at ice and steam points the thermometric property is found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric property 3.5?	10	L3	CO1
		OR			
Q.2	a.	Show that thermodynamics definition for work is superior to mechanics definition.	05	L1	CO1
	b.	With a neat sketch, explain working principle of constant volume gas thermometer.	05	L2	CO1
	c.	A perfect gas is undergoing a process in which $T \alpha V^{2/5}$. Calculate the work done by the gas in going from state 1 in which the pressure is 100 bar and volume is 4 m^3 to the state 2 in which volume is 2 m^3. Also calculate the final pressure.	10	L4	CO1
		Module – 2			
Q.3	a.	State the first law of thermodynamics along with the mathematical expression for the following: (i) A closed system undergoing a cycle (ii) A closed system undergoing a change of state.	05	L1	CO2
	b.	With a neat sketch of steady flow device, write the steady flow energy equation with usual notations.	05	L1	CO2
	c.	A stationary mass of gas is compressed without friction from an initial state of 0.3 m^3 and 0.105 MPa to a final state of 0.15 m^3 and 0.105 MPa, the pressure remaining constant during the process. There is a transfer of 37.6 kJ of heat from the gas during the process. How much does the internal energy of the gas change?	10	L3	CO2
		OR			
Q.4	a.	Write the steady flow energy equation for (i) Boiler (ii) Centrifugal pump.	05	L1	CO2
	b.	Show that energy is a property of the system.	05	L2	CO2
	c.	In a certain steady flow process, 12 kg of fluid per minute enters at a pressure of 1.4 bar, density 25 kg/m^3, velocity 120 m/s and internal energy 920 kJ/kg. The fluid properties at exit are 5.6 bar, density 5 kg/m^3, velocity 180 m/s, and internal energy 720 kJ/kg. During the process, the fluid rejects 60 kJ/s of heat and rises through 60 m. Determine work done during the process in KW.	10	L4	CO2

		Module – 3			
Q.5	**a.**	Define thermal efficiency of a heat engine and COP of a refrigerator along with mathematical expressions for both. Write their schematic diagram.	05	L1	CO3
	b.	Define entropy and show that it is a property of the system.	05	L2	CO3
	c.	A reversible heat engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by 62°C, its efficiency is doubled. Find the temperature of the source and the sink.	10	L4	CO3
		OR			
Q.6	**a.**	State and prove Clausius theorem.	05	L2	CO3
	b.	Give the Kelvin-Plank and Clausius statements of the second law of thermodynamics.	05	L1	CO3
	c.	A lump of steel of mass 10 kg at 627°C is dropped in 100 kg of oil at 30°C. The specific heats of steel and oil are 0.5 kJ/kgK and 3.5 kJ/kgK respectively. Calculate the entropy change of steel, the oil and the universe.	10	L3	CO3
		Module – 4			
Q.7	**a.**	Define Available Energy (AE) and Unavailable Energy (UE). Show that unavailable energy is the product of lowest temperature of heat rejection and the change in entropy of the system during the process of supplying heat. Draw the necessary schematics and T-S diagrams.	10	L4	CO4
	b.	With a neat sketch, explain the working principle of separating and throttling calorimeter.	10	L2	CO4
		OR			
Q.8	**a.**	In a certain process, a vapor, while condensing at 420°C, transfers heat to water evaporating at 250°C. The resulting steam is used in a power cycle which rejects heat at 35°C. What is the fraction of the available energy in the heat transfer process from the vapour at 420°C that is lost due to the irreversible heat transfer at 250°C?	10	L3	CO4
	b.	Draw the phase equilibrium diagram for a pure substance on P-T coordinates and show the fusion curve, vaporization curve, sublimation curve, triple point and critical point.	10	L2	CO4
		Module – 5			
Q.9	**a.**	Write notes on: (i) Daltons law of partial pressure (ii) Amagots law of additive volumes (iii) Compressibility factor (iv) Law of corresponding states (v) Generalized compressibility chart	10	L2	CO5
	b.	One kg of ideal gas is heated from 50°C to 150°C. Determine: (i) Change in internal energy (ii) Change in enthalpy (iii) Change in flow energy (iv) $\overline{C}_V$ and $\overline{C}_P$ Take R = 280 kJ/kgK; $\gamma = 1.32$ for gas.	10	L3	CO5
		OR			
Q.10	**a.**	Derive: (i) Maxwell's equations (ii) The first and second Tds equations.	10	L2	CO5
	b.	Find the gas constant and apparent molar mass of a mixture of 2 kg O_2 and 3 kg N_2 given that the universal gas constant is 8314.3 J/kgK, molar mass of O_2 and N_2 are respectively 32 and 28.	10	L3	CO5

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CBCS 22 SCHEME

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BMEL305/BRIL305

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024

INTRODUCTION TO MODELLING & DESIGN FOR MANUFACTURING

Time: 3 Hours | Max. Marks:100

Note: 1. Use **First angle** projections only.
2. All the dimensions are in mm.
3. If any data is missing it may be suitably assumed and mentioned.

Part A

1. Create a two-dimensional illustration based on the diagram provided in Figure 1

20 Marks

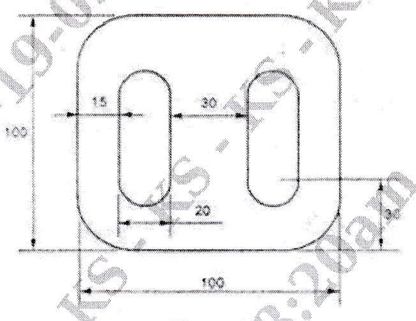

Figure 1

Part B

2. Draw the sectional front view and side view of a "**Flanged Coupling - Unprotected type**" as shown in Figure 2.

30 Marks

Part C

3. Figure 3 shows the details of a "**Screw Jack**". Assemble the parts show the following views.
   a. Half sectional front view.
   b. Top view

50 Marks

	Examiner 1	Examiner 2
Name :		
Signature with date :		

CBCS 22 SCHEME

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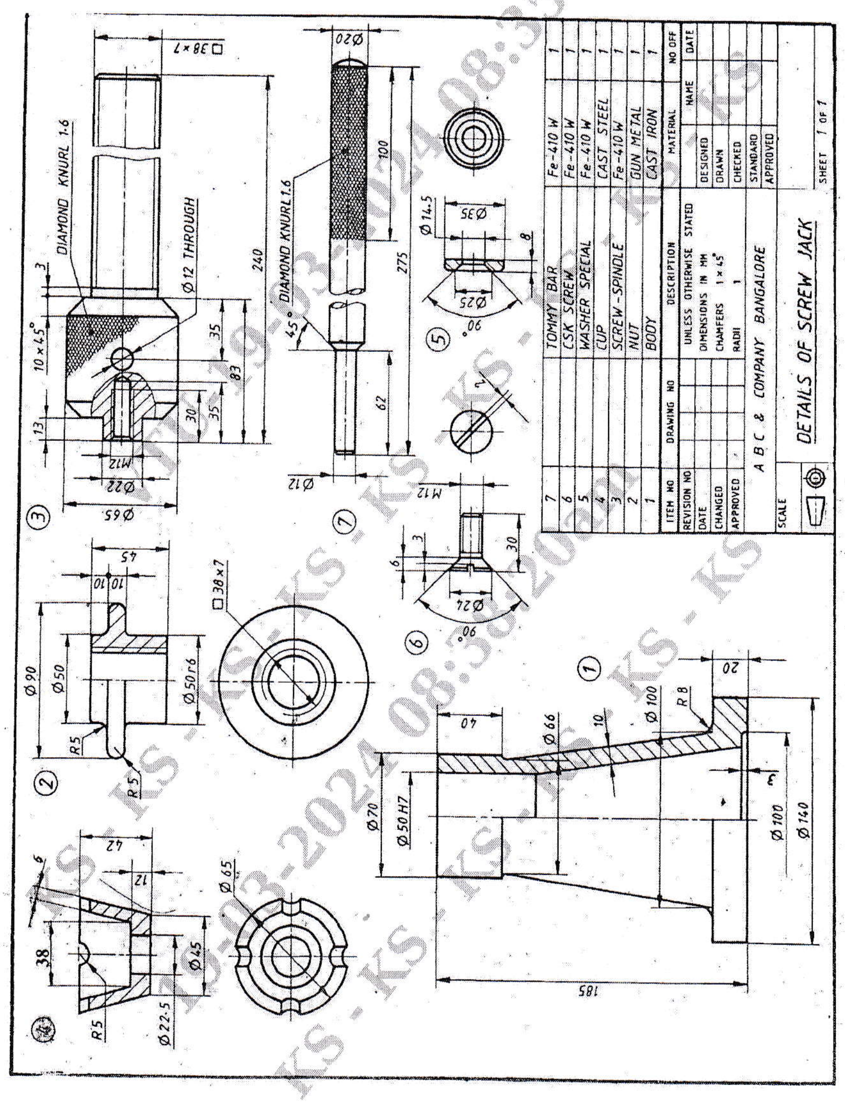
BMEL305/BRIL305



Details of a Screw Jack

Figure 3: Details of Screw Jack

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BME306A

Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024

Electric and Hybrid Vehicle Technology

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Explain the fundamental components of a hybrid drive train, distinguishing between series and parallel hybrid configurations.	10	L2	CO1
	b.	Enumerate and explain the advantages of electric and hybrid vehicles over conventional internal combustion engine vehicles.	10	L3	CO1
		OR			
Q.2	a.	Identify and discuss the limitations and challenges faced by electric and hybrid vehicles.	10	L2	CO1
	b.	Examine the challenges related to the disposal of batteries and hazardous materials used in electric and hybrid vehicles, emphasizing the environmental risks.	10	L3	CO1
		Module – 2			
Q.3	a.	Evaluate the key functionalities of a BMS and their impact on the overall efficiency and reliability of energy storage systems.	10	L3	CO2
	b.	Classify major type of rechargeable batteries considered for EV and HEV applications and evaluate the overall working principle of Li-Ion batteries with chemical reaction.	10	L2	CO2
		OR			
Q.4	a.	Classify type of fuel cells and evaluate the overall working principle of hydrogen fuel cell in production of electricity by mean of chemical reactions.	10	L3	CO2
	b.	Discuss the concept of hybridization of various energy storage devices.	10	L2	CO2
		Module – 3			
Q.5	a.	List the various types of motor. Discuss the key parameters involved in the selection and sizing of electric motors for various applications.	10	L3	CO3
	b.	Explain the working principles of permanent magnet motors drive and its characteristics.	10	L2	CO3
		OR			
Q.6	a.	Explain the working principles of brushless DC motors drive and its characteristics.	10	L2	CO3
	b.	Explain operation of the three-phase induction motor and its control characteristics.	10	L2	CO3
		Module – 4			
Q.7	a.	Explain the essential characteristics influencing the design of batteries, ultra-capacitors and fuel cells in electric vehicles.	10	L3	CO4
	b.	Illustrate the importance of aerodynamic features in EV and HEV vehicles design and their impact on overall performance.	10	L3	CO4

OR					
Q.8	**a.**	Explain combined effects of rolling resistance, grade resistance and acceleration force to determine the total tractive effort required for vehicle motion.	**10**	**L3**	**CO4**
	b.	Provide an overview of how vehicle mass considerations impact design decisions, energy consumption and overall performance.	**10**	**L3**	**CO4**
Module – 5					
Q.9	**a.**	Explain understanding of smart charging, emphasizing the interaction between the grid and the vehicle.	**10**	**L2**	**CO5**
	b.	Describe the concept of vehicle-to-vehicle communication systems, introducing the potential benefits and applications.	**10**	**L2**	**CO5**
OR					
Q.10	**a.**	Discuss the installation and commissioning process of battery charging stations, considering the necessary steps and requirements.	**10**	**L2**	**CO5**
	b.	Examine various types of connectors used in electric vehicle charging infrastructure, highlighting their differences and applications.	**10**	**L2**	**CO5**

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