Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Integrated Dual Degree (B.Tech and M.Tech)
Sub_Code: RBM2B001

2nd Semester Back Examination: 2023-24
SUBJECT: Basic Mechanical Engineering
BRANCH(S):
AEIE,AUTO,CIVIL,CSE,CSEAI,CSEAIME,CSEDS,CST,ECE,EEE,ELECTRICAL,ELECTRICAL & C.E,ETC,MECH,MINERAL,MME
Time: 3 Hour
Max Marks: 100
Q.Code: P524

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Differentiate between intrinsic and extrinsic thermodynamic property with examples.
b) Define entropy. Highlight its characteristics
c) Describe different thermodynamic processes occurring in a Carnot cycle.
d) Explain the term “enthalpy” in a thermodynamic system. How does it relate to the internal energy of a system?
e) Describethird law of thermodynamics.How does it relate to absolute zero concept?
f) Why are petrol engines termed as SI engine and diesel engines termed as CI engines?
g) What are the primary components of a robot's anatomy?
h) Define the terms: precision and accuracy in mechanical measurements.
i) Mention the advantage of double-helical gear over single-helical gear.
j) Distinguish between gas and vapor.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 × 8)**

a) State second law of thermodynamics. How does the second law of thermodynamics relate to the concept of entropy, and what role does it play in determining the direction of natural processes?
b) Explain the significance of phase transitions in the behavior of pure substances, and how they relate to thermodynamic properties such as enthalpy and entropy?
c) What is the function of brake? How does it differ from clutch? What are various types of clutches?
d) What is the function of coupling? What are the requirements of a good coupling? How are the couplings classified?
e) Define entropy. Discuss its characteristics. Describe principle of increase of entropy in a thermodynamically isolated system.
f) Name the tools or instruments used for measurement of temperature, pressure, velocity, flow, and stress and strain in any complex mechanical systems. Also, explain the working principle of any two of these measuring devices.

g) What are the primary methods of transmitting motion and power in mechanical systems? Discuss the function and importance of gears in power transmission systems.

h) Describe the components and stages of the Rankine cycle used in power generation. Compare and contrast the Rankine cycle with Carnot cycle.

i) Explain the significance of steady flow energy equation in engineering thermodynamics. Provide an example illustrating its application in real-world engineering scenarios. Discuss the assumptions made in deriving the steady flow energy equation.

j) Define dryness fraction of steam. How do you estimate the dryness fraction of steam ina given system, and what are the key factors that influence it?

k) A Carnot cycle operates between source and sink temperatures of 300°C and –20°C. If the system receives 100 kJ from the source, find: (I) Efficiency of the system, (II) The Net work transfer, and (III) Heat rejected to sink.

l) Describe different types of belt drives with neat sketches. Explain the pros and cons of belt drives over rope drives.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 a) During process A, the system receives 20 kJ heat and produces 30 kJ work. The process B between same end conditions, receives 15 kJ heat. Determine the change in internal energy during the process and work done in process. Prove that if the cycle is formed using processes A and B, the given data confirms the first law of thermodynamics. **(8+8)**

b) In air compressor air enters at 1.013 bar and 27 ^{0}C having volume of 5 m^3 and it is compressed to 12 bar isothermally. Determine (I) work done, (II) heat transfer, (III) change in internal energy.

Q4 a) Air at 12 ^{0}C and 85 kPa enters the diffuser of jet engine steadily with a velocity of 220 m/s. The inlet area of the diffuser is 0.38 m^2. The air leaves the diffuser at a negligible velocity compared to inlet velocity. Calculate (i) mass flow rate of air (ii) the temperature of air leaving the diffuser. **(8+8)**

b) A lump of 800 kg of steel at 1250 K is to be cooled to 500 K. If it is desired to use steel as source of energy. Calculate available energy and unavailable energy. Consider specific heat of steel as 0.5 kJ/kg K and ambient temperature is 300 K.

Q5 a) Explain the principle of operation and applications of a strain gauge-based load cell in mechanical measurements. Provide a detailed overview of the working mechanism, including the factors affecting its accuracy and sensitivity. **(8+8)**

b) Explain the working principle, construction, and applications of a Bourdon tube pressure gauge in mechanical measurements.

Q6 a) Describe the general applications and advantages of gear and belt drive systems. **(8+8)**

b) Describe the anatomy of a typical industrial robotic arm and its components. How do these components work together to achieve precise and flexible movements?